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**A THESIS PRESENTED TO THE OPEN UNIVERSITY FOR THE
DEGREE OF MASTER OF PHILOSOPHY**

SYSTEMS DEPARTMENT

TECHNOLOGY FACULTY

NOVEMBER 1995

**FARMERS ATTITUDES TOWARDS INFORMATION SOURCES AND
THEIR SUBSEQUENT CROP PROTECTION BEHAVIOUR**

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Abstract

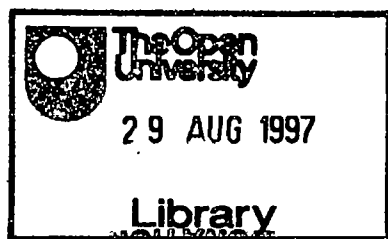
The literature contains many studies of the various factors that could contribute towards the use of pesticide by farmers. However, not all of these factors have been investigated. This research looked into the links between information sources and the use of pesticides; and focused particularly on the attitudes and behaviour of farmers towards both these aspects.

A review of several models proposed to explain attitudes and behaviour was undertaken and Fishbein and Ajzen's model was chosen to investigate farmers attitudes and behaviour towards information sources and pesticide use.

The first, preliminary, survey of farmers in West Sussex produced an unexpected result: that they did not apply pesticides as many times as they had indicated at the beginning of the growing season. Systems analysis using the Failures methodology identified areas where anomalies had occurred. It also showed that systems of crop protection were dynamic.

Analysis of the second survey yielded the same result as the first survey, that they changed their behaviour in the light of new information. This was not the result predicted by the Fishbein and Ajzen model. However, the analysis also yielded important information, namely that the farmers behaved according to their beliefs. The analysis showed that their normative belief was less significant than their attitudinal belief. The second survey also showed that farmers did not depend on external sources of information but relied on their own judgements

Shortcomings of the Fishbein and Ajzen model are considered and suggestions to overcome this problem are proposed.



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Chapter 1 Introduction

1.1 *Technology and agricultural change*

There has been considerable change to the agricultural systems of the United Kingdom (UK) in the 20th Century. This change has been driven by Government policy, financial intervention and technological change to varying degrees (Open University 1987). For instance, the efforts to make the UK more self supporting in terms of food production during the Second World War helped to reverse the decline in arable acreage in some areas which had followed the 1914-18 War (Blunden and Curry 1985), and was primarily due to the 'plough up' campaign which turned grassland over to root crops and cereals. Changes in agricultural production were further stimulated with the introduction of the Agriculture Act of 1947. The resultant expansion in many crops was made possible by a system of guaranteed prices for most farm outputs with prices reviewed annually. Furthermore a grant was made available whereby farmers were offered £19.00 per acre to plough grassland. The net result of such offers led many farmers, particularly in areas like Sussex, to remain as cereal growers rather than livestock keepers (Hodgson 1967). More recently the UK's entry into the Common Market in 1974 also stimulated agricultural production as well as creating many other changes.

1.2 *Agricultural change and crop protection practice*

The use of agrochemicals is one of many technological innovations adopted by farmers in the UK that has contributed to this increased production (Lane 1983). Pesticides were particularly used on cereals following the sudden increase in the market value of the crop after entry into the Common Market. Norton (1976) states that such a strategy is often adopted on any crop following an increase in its market value because the crop has become a more important source of income. In other cases, such as oilseed rape, pest

problems have become more prominent the longer and more widely the crop has been grown (Lane 1984).

The adoption of new technologies can be both beneficial and detrimental at the same time. Among the side effects of using pesticides are pest resistance and the killing of natural enemies and other non-target organisms. These have caused a number of users to be locked into what has become known as the 'pesticide treadmill' (Tait 1977). This term denotes a self fuelling trend towards an ever escalating and more costly pesticide usage to protect an ever more valuable crop from more persistent pest problems.

Groups of people concerned with the use of pesticides have become sources of pressure for change in crop protection practice. Those against the use of chemicals argue that pesticides are alien to the environment and have the potential to disrupt a wide range of ecosystems from soil microbes through to higher animals, for example the thinning of egg shells of birds of prey by DDT (Sheail 1985).

However, as pointed out by Lane (1983) detrimental effects to an agroecosystem can be caused by new crops, varieties or cropping systems being adopted by the farmer as much as by pesticide use alone, as he recorded for oilseed rape in the UK. Further examples of detrimental impacts have been noted for the introduction of hybrid maize in the USA (Griliches 1960) and new rice varieties in Asia (Lane 1981), where production of the crops involved the use of large amounts of fertilisers to sustain yields as well as the use of insecticides. In fact, the interplay between different technologies sometimes leads to unexpected problems. An example is provided by the production of sugar beet where the adoption of precision drilling and the increasing use of herbicides meant that seedling pest damage is potentially worse and virus yellows may be encouraged (Lane 1983). Mumford (1981) also pointed out the increasing concern of the effects on soil structure following heavy application of herbicides.

1.3 Farmers responses to pest problems

The use of pesticides by farmers is but one response they can take towards attacks by pests. In attempting to contain or prevent pest problems, a farmer will attempt to assess what pests are present in his crops, the potential damage from these pests, the frequency of their occurrence, what control methods are available and the cost as well as the efficiency of these methods (Norton 1976). Indeed, Mumford (1981) and Lane (1981) have both been able to predict farmers' actions by using farmers own estimates of these factors in simple decision-making models. Tait (1978), however, said that the scale of pesticide use varied between farms more than between crops on the same farm, despite differences in actual pest problems in these crops. This reinforces Norton's (1976) suggestion that it is usually the perceptions of the factors involved that is the deciding factor in pesticide usage, rather than an actual, measured level of these factors.

Lane's (1983) study on farmers' perception of pest problems and their control shows that perceptions originate from two main sources:-

- (a) from research, field trials and the experience of advisors, transmitted through written or verbal means to the farmers.
- (b) from farmers' own experience and observation of events.

In the case of the production of oilseed rape Lane (1984) was able to show that the use of insecticide tended to vary according to the grower's experience with the crop. More experienced growers were quoting pest problems more frequently than less experienced growers and using significantly greater numbers of spray rounds. This is possibly due to a combination of both increased attacks and of changes in perception of the pest infestation, some of this perception being influenced by their sources of information and advice.

1.4 Crop protection and sources of information

Present day farmers have access to many types of mass media such as books, pamphlets, magazines, TV, radio or meetings which are sponsored by public or private bodies.

There are also other sources of information such as the Agricultural Development and Advisory Service (ADAS), retail dealers, other farmers, and independent crop consultants. Furthermore they can often accumulate information by interpreting their own and other peoples' experiences with new technology. Lastly farmers can obtain information by reading the instructions or information that comes with agrochemicals they have purchased.

A survey carried out by Farmers Weekly (Anon 1984) showed that the provision of technical information on agricultural matters has rapidly become a thriving service industry in agriculture (see Table 1.1) Nearly nine out of ten farmers have used these services. The survey also showed that agrochemical manufacturers and merchants remain an important source of information with 67% of growers using their services, although independent consultants are increasingly consulted.

There are various factors which govern what sources of information farmers will use. The two factors which stand out are the availability and the credibility of information sources. From the various sources of information available to farmers the sources deemed to be most credible will most likely be selected.

This credibility is often achieved by good communication. Merchant's representatives offer such credibility as a source of information and advice. Source credibility was defined by Hovland et al (1953) as the perceived expertise and trust worthiness of a communicator. The studies carried out by Hovland et al (1953 , 1959) have demonstrated that an identical persuasion message will produce more change in attitudes

if the message was attributed to a credible source rather than if the message had come from a less credible source.

Table 1.1 The percentage of farmers seeking advice on particular topics and their first choice of advisor in each case. Source: Anon (1984)

Subject	% of farmers seeking advice on subject	First choice of advisor
Cereal agrochemicals	61	Merchant rep.
Fertilisers	55	Merchant rep.
Animal health - prevention	49	Vet
- curative	49	Vet
Animal feed	43	Merchant rep.
General animal husbandry	41	ADAS
New machinery	35	Machinery dealer
New chemicals	34	Merchant rep.
Livestock chemicals	12	ADAS
Crop innovation	12	Merchant rep.

1.5 Information and the adoption of new technology

The use of information sources in the process of the adoption of new technology or new farming practices has been studied by various people. Wilkenning (1956) stated that various sources are used to obtain different types of information. He suggested three stages for the adoption process, namely the awareness stage, the information stage, and the trial stage. Sources of information, according to his study, are an important input in every stage of the process, although in the USA, mass media is involved mainly in the awareness stage. Such sources are referred to by Rogers and Beal (1958) as impersonal

sources, but they still play an important role in the process of adopting of new technology.

1.6 Farmers attitudes to agrochemicals and information sources

Attitudes are an important variable that have been studied by several researchers in order to understand, predict and modify farmers behaviour with regard to the use of agrochemicals (Carr 1988, Griliches 1960, Gladwin 1977, Lane 1981, Merchant and Teetes 1994, Tait 1977,1978).

However while Griliches' study into farmers' attitudes carried out in Iowa USA showed that the majority of farmers appear to have favourable attitudes towards the role of agrochemicals, the findings do not indicate whether or not statements which the investigators put forward are actually attitudes or beliefs. The statements by the Iowa farmers that were considered to be their attitudes to agrochemicals were:

- 1) The proper use of agrochemicals is the best way to get rid of nuisance plants and control pests and thus stave off disease and starvation in many parts of the world.
- 2) Agrochemicals are one of the main factors which contribute towards the standard of living in the USA. They are the essential tool for farmers to produce good food at reasonable prices. Food produced before the introduction of agrochemicals did not contain less contaminant and the quality was poorer.
- 3) Agrochemicals are a profitable input in the farmers operation.

The study carried out by Tait (1983) in the UK looked at farmers salient beliefs as well as their attitudes towards pesticide usage on brassica crops. The results showed that farmers did not believe that organochlorine insecticides, such as dieldrin and aldrin, had harmful effects on the environment whilst demeton-s-methyl was more widely believed to be dangerous and damaging.

Tait also studied farmers' individual attitudes to the financial risk dimension as well as to environmental risks and personal health risks. The study showed that of the three risk dimensions, opinions on the financial risk most accurately predict the use of insecticides in general. However Tait also revealed a surprising result, namely the level of internal inconsistency in attitudes expressed by many farmers, in that those using most pesticides sometimes had the most favourable attitude towards their environmental impact. According to Tait this could mean an unstable situation, and a change in external circumstances could precipitate unexpected changes in the behaviour of farmers.

1.7 Discussion

This chapter has briefly described how policy, financial incentives and technological innovations have caused changes in farming practices since the Second World War. High yields have been made possible by agrochemicals both for enhancing growth as well as protecting crops from various pests. The increasing use of these chemicals, particularly those used for crop protection purposes, has alarmed some people concerned with the environment; both experts and lay people. Yet in spite of the existence of pressure groups, the demand for these chemicals from farmers has not decreased much. One of the factors which has sustained the demand for agrochemicals has been the communication skills of those hired to sell the products. These communicators have managed to establish a stable system where information flows both ways; from the communicators to the farmers and vice versa.

The farmers' attitudes towards pests and pesticides is a variable that must be studied to understand their behaviour regarding the use of agrochemicals. It is also necessary to establish the structure of the crop protection system within the farming system under study if the use of information by farmers to make their crop protection decisions is to be understood.

1.8 The objectives of this research

The objectives of this research were to:

- 1) examine various decision making and attitude models (Chapter 2);
- 2) establish the crop protection behaviour within the farming system under observation and to survey farmers in that chosen farming system (Chapter 3);
- 3) understand the crop protection decision making in the farming system under observation and in particular to estimate the influence information sources have on farmers' perceptions of pest attack(Chapter 4);
- 4) examine the relationship of farmers' attitudes and beliefs with their information sources and subsequent crop protection behaviour (Chapter 5);
- 5) establish whether such behaviour is affected by their information sources or by their own attitudes and beliefs (Chapter 6).

Chapter 2 Decision making and attitude models

In this chapter, various models are examined that attempt to explain farmers' attitudes towards information systems and their resultant decision making processes. The model to be used for this research should be able to provide explanations of both the decision making component as well as the attitude component of the area being studied.

2.1 Dissonance model

Festinger (1957) based his theory of dissonance on the assumptions that an individual will strive towards consistency between attitudes and behaviour within him/herself.

Thus, the definition of a state of dissonance according to Festinger is:

'Two elements are in dissonant relation if, considering these two alone, the obverse of one element would follow from the other...'

The elements mentioned by Festinger are cognitive ones such as a piece of knowledge, belief or opinion, either about one's environment or about oneself. These elements can be found in one of three relationships: dissonant, consonant or irrelevant. For example, a dissonant relationship was seen in the farmers surveyed (see Chapter 3 for details) where they completed the spray programme in May, rather than in late June or July, even though they were aware that there is always a threat of aphid attacks in June, particularly in dry conditions. Most of them believe that ideally, they should spray in June, and yet they are prepared to take the risk of not spraying.

The magnitude of any dissonance, according to Festinger, is a function of the following two conceptual variables. The first is the importance of each of the dissonant and cognitive elements; if an opinion has little importance then behaviour inconsistent with that opinion creates relatively little dissonance. For instance, the greater the farmers' belief that aphids are likely to infest in June, the greater the dissonance felt when they cease to spray in April/May.

The second variable is the ratio of dissonant to consonant elements; the greater the ratio the greater the dissonance felt. Festinger sets an upper limit to the amount of dissonance existing between two elements as equal to the resistance to change of the less resistant element. If the dissonance is magnified beyond this point, the less resistant element will be changed to conform with the other. Dissonance is thus reduced. For instance, farmers who cease applying pesticides in May may believe that spraying against aphids in June is common sense, but due perhaps to external pressure from consumers who express the opinion that too much spraying is counter productive, the attractiveness of ceasing spraying in May has thus increased.

Festinger also discusses the theory's implications for various situations, and specifically the decision making process. As in the examples above, dissonance is often associated with choices or decisions. All decisions involve conflict before resolution, and only after resolution can dissonance be said to exist (Brehm and Cohen 1962). Thus, dissonance is a post decisional conflict. To consider a further example, farmers who continue to spray until harvest time are only likely to choose an alternative that is more attractive than another, and this in itself must produce dissonance and thus give rise to pressure to reduce that dissonance. Although dissonance helps provide one model of the outcome of making choices, it does not indicate the influence of information on attitudes or beliefs.

2.2 *Decision making models*

To analyse farmers' decision making, various models of decision making using a standard normative approach, an anthropological approach and a psychological approach, were investigated. However it should be noted that many of the studies carried out by anthropologists are on farmers in developing countries, which raises the question of whether one can compare uncertainties and decisions taken in developing

countries with those in developed countries (Open University 1987). Ortiz (1973) suggested that should not be a problem because, although peasant studies do provide a particular 'model' in the eyes of researchers, they are not totally different from the models in developed countries based on the market economy. This view is supported by Cancian (1972) who stated that the question of whether peasant farmers are economic maximisers or prisoners of tradition is a bogus one that leads to a scientifically incorrect and politically dangerous description of peasant societies. Thus, the important issue here is to see if the farmers' decisions on pest control are a result of internally developed strict maximisation formulae, or of other reasons such as external advice, which may not necessarily be culturally dependent.

2.2.1 Normative approach to decision making

The normative approach to explain farmers' decision making (Plattner 1974) assumes that when alternative choices are combined with the farmers' goals and values, the appropriate choice can be calculated. The appropriate choice is assumed to be the choice that will maximise the attainment of goals. Based on this principle, for example, a farmer may have chosen to complete their spray programme by May in order to get the best result in terms of return on investment.

Further criticism of the normative approach comes from anthropologists. Cancian (1980) rejects the normative model of decision making by stating that, where risk is involved i.e. where perfect knowledge and certainty are lacking but probabilities of various alternatives are known, the normative approach may be too complicated for farmers to produce an expected solution.

Savage (1964) on the other hand, said that under uncertainty, the best way to achieve the maximum attainment of a goal is to use whatever information is at ones disposal to make the best guess about probabilities. Savage shows that uncertainty mitigated by

even a little information from an expert or client is much better than no information at all in reaching the goal of maximisation.

The question then is, if the probabilities worked out by the farmer suggests that pests would not be a problem in a particular year, then why apply insecticide at an earlier stage of the crop?

In a situation like this it is not clear whether the decision follows the belief about pest attack or the belief follows the decision (Cancian 1980). Cancian's reasons for this criticism of the normative approach are that:

- (i) best guesses are more subjective rationalisations than objective calculations, and
- (ii) there are other factors such as social position and uncertainty about information that influence decisions.

Cancian further argues that this decision making model does not separate risk from uncertainty and that it should be a crucial factor in understanding decision making. For instance, farmers face the risk annually of what the weather will bring for that year. A wet year will encourage mildew and weeds on wheat, a dry year will be ideal for aphids. An experienced farmer will know the approximate rainfall pattern in his/her area, thus he/she will know approximately, the risks of pest attack on their wheat crop. Therefore, if drought has been a constant feature of the weather, the farmers are more likely to spray against aphids, making it a risk factor. In contrast the adoption of a new crop protection method involves uncertainty because until the method has been tried for at least one year of crop production, the likely outcome cannot be calculated.

2.2.2 Anthropological approach

Cancian (1980) incorporated the distinction between risk and uncertainty into a theory relating behaviour to economic rank. This theory is based on three fundamental assumptions, namely that:

- (a) all farmers prefer a higher economic status in their community to a lower economic status;
- (b) in general, because they have the resources to withstand loss, large farmers and rich farmers are more likely to adopt or experiment with new practices than poorer farmers;
- (c) that under conditions of high uncertainty, all farmers face the possibility that they may suffer heavy losses and each must make a decision without any indication of the outcome.

However, it could be argued that based on these principles, smaller farms may be more willing to experiment as they cannot sink any lower in the socio-economic structure.

2.2.3 Elimination by aspect approach

Tversky (1969), a psychologist, proposed a model called 'elimination by aspects', which essentially claims that alternatives are presented to the decision maker and each alternative is considered against various criteria or aspects. His model requires that a particular alternative chosen must be acceptable on all aspects, otherwise it will be rejected. For example, for farmers who have completed their spray programme in May, the alternatives might include: a) routine spray, b) spray only when necessary, c) no spray after spring. For each of these alternatives, the following criteria might be considered:

1. Will it be expensive?
2. How well can the method contain a pest problem?
3. Have I got enough labour to use it?

Elimination by aspects assumes that if the answer to any of these questions is no, that alternative will be rejected from further consideration.

According to Gladwin (1975,1977), the selection of aspects in Tversky's model is probabilistic, thus the aspect selected to eliminate alternatives may vary in repeated

decisions and therefore for the alternatives that are not eliminated, the choices may vary in repeated decisions. Tversky's theory thus explains the observed inconsistencies in choice behaviour i.e. at different points in time people make different choices. Based on this model, the decision taken by the farmers observed from these two areas in West Sussex, in terms of their crop protection method, can be explained as follows: where the conditions for production have remained constant, i.e. the weather pattern has been the same for several years, the farmers are able to choose their protection method knowing approximately the probabilities of pest problems in relation to the weather. Thus they have been confident that without any further application of pesticide, at post Spring time growth there will be no serious infestation. Every year they are faced with a number of choices for crop protection methods and their decision making can be made easier when the weather pattern is unchanged.

2.2.4 Real life choice approach to decision making

The elimination by aspect model is regarded as too simplistic by Gladwin (1975,1977) to be a complete account of situations where decision makers are deliberating over choices made difficult by competing aspects. In spite of her rejection of Tversky's model, Gladwin's decision making model follows the assumptions made by Tversky (1969), namely that alternatives are measured against a set of characteristics or aspects. For example, some aspects of a pesticide could be its cost, its effectiveness in controlling pest problems or its distinctive side effects. Gladwin does go on to say that all aspects are discrete. By this she means that if the decision maker uses a continuous quantitative dimension such as cost, they either treat it as a constraint, (e.g. is the cost greater or equal to the sum borrowed from the bank?) or categorise it using another attribute (e.g. two identical chemicals with identical costs, one is a known brand while the other is a product of a lesser known manufacturer, then the choice falls on the known brand).

Gladwin's model is divided into two stages, which will be illustrated below by a pest control decision based largely on the findings reported in later chapters:

(i) Stage one of Gladwin's model

Stage one is identical to Tversky's (1969) choice process of elimination. However, Gladwin criticises Tversky's selection of aspects method by saying that although the theory is intuitively possible and theoretically appealing, it is not clear whether people select aspects probabilistically or follow a deterministic choice procedure. She further states that a deterministic choice procedure could select different aspects over time, whereas the Tversky's choice process stops when one alternative remains after the elimination of all others. Gladwin proposes one stage further where the decision is made by the decision maker using his/her attentive consciousness. She also states that the boundary between stage one and stage two is the boundary between unconscious action and conscious choice.

(ii) Stage two of Gladwin's model.

This stage is broken down into six steps:

Step one ~ Aspects of at least one alternative are mentally listed or considered. Some people in her study ended by listing the alternative choices and drawing a line in the middle when the choice became difficult. For example, using step one of Gladwin's decision making model, the choice of farmers in the survey not to spray post spring growth might be depicted as shown in Table 2.1.

Table 2.1 The possible choice of aspects and outcomes of farmers spraying decisions based on Gladwin's model

Aspect of alternatives	Outcome of spraying until Spring.	Outcome of routine spray i.e. spraying until harvest
1.Controls the problem.	Risks involved but effective chemicals can be used in an emergency	Very good.
2.Creates cross resistance.	Natural balance better maintained.	It can be a problem, thus more chemicals needed.
3.Leads to yield loss.	No evidence of losses due to pests. Possible loss due to drought.	No losses due to pests, possible loss due to drought.
4.Leads to plant damage due to spray machine.	There is little damage.	There is damage.
5.Leads to chemical residues.	Less than routine spray.	More than spray until Spring.
6.Requires labour.	Less labour intensive.	More labour intensive.
7.Costs.	Less because less chemicals used, but risk crop losses if control system fails.	High, but of a relative security, as no plant damage due to pest/pathogen.

Step two ~ Here Gladwin says that the decision maker eliminates, or does not consider some aspects for the purpose of simplifying the decision process. Below is a list of heuristics that she suggests could be used by the decision makers to eliminate aspects:

- (a) If an aspect has little or no relevance to the decision maker then it is eliminated.
- (b) If two alternatives have equal or equivalent values, that aspect is eliminated. For example, if yield per hectare is around six tonnes using the routine spray method and the same output is achieved using the other method, then that aspect becomes irrelevant to the decision.
- (c) If two aspects are of equal or equivalent importance and the ordering of alternatives against one aspect is the opposite to the ordering of alternatives against the other, then both aspects are eliminated.
- (d) If one aspect effects the decision process only through another aspect and does not have a separate effect, the two aspects are considered as one aspect. For example, farmers may consider aspects of cross resistance and chemical residues together. Both may be considered undesirable aspects of the routine use of agrochemicals, and so increase the likelihood of eliminating routine spraying as an alternative.

Step three ~ Here, Gladwin states that from the subset of aspects that are not eliminated, the decision maker selects one aspect on which alternatives are ordered. At this step, the selection of aspects in the choice process is deterministic and not probabilistic as in stage one. This means, as stated by Gladwin, that:

"Given the same set of aspects after step 2, the decision maker will always select the same ordering of aspects in repeated decisions."

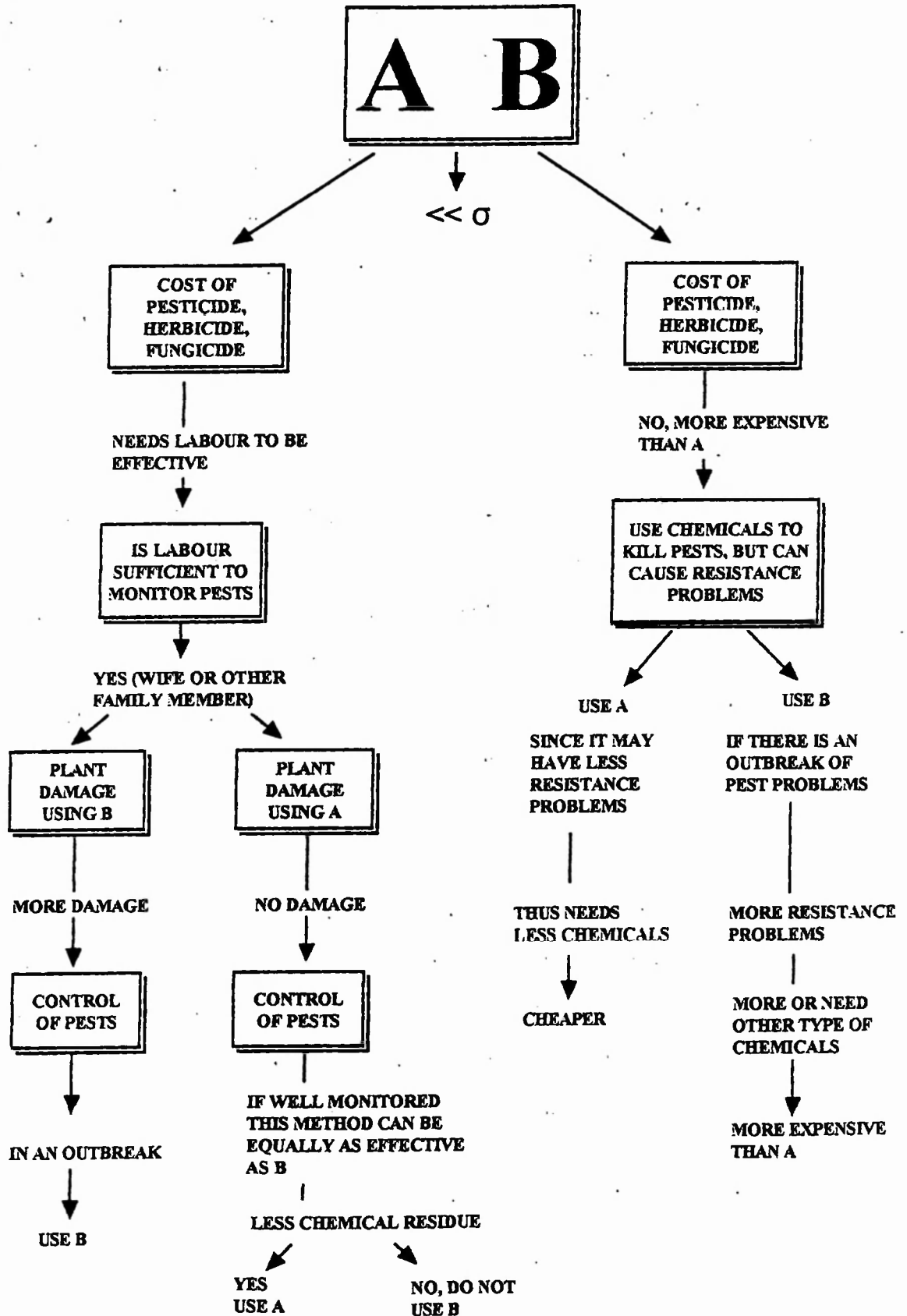
Thus it is possible to construct a likely decision flowchart for farmers who had to choose between spraying until spring and the routine method, using the same ordering of aspects (see Figure 2.1). First, costs of chemicals are known to be more expensive for the routine method than the spray until spring method. On the left-hand branch of the chart farmers are faced with the first constraint, namely labour requirements. To be effective, spraying until spring needs people to monitor the fields. The farmers may not

have enough resources to hire extra hands in this situation, so the farmer shifts to the right-hand side of the tree. If the labour is available, the two alternatives are compared on the aspect of damage to the crop. Since the method of spraying until spring ceases before plants have reached full leaf canopy, which prevents the chemicals from reaching their target, plant damage from pests is expected to be minimal. In this case, the model predicts that the farmer will choose the method of spray until spring. However, in the case of an outbreak of pests, the method loses its advantage. In spite of this, when the method is compared on the effectiveness on controlling pests with the routine method, it is about equal provided that the monitoring system is tight enough. Moreover, the chemical residue is less.

On the right-hand branch of the tree, the routine spray method offers the aspect of controlling pests through the use of more chemicals, thus helping the farmer with his lack of labour (it does not require many people to monitor the fields). In this case, the model predicts that he will choose the routine spray. However, using the constraint of resistance problem, the model predicts that the farmer will choose the alternative method, because without the problem of resistance, the farmer does not need to apply more pesticide. Thus, there is no cost escalation.

The decision flow chart illustrates a common feature of real life decisions, namely that some constraints are included on some paths but excluded on others. This means that a number of constraints that are suitable on some paths, are not suitable on others. For example, the constraints of resistance problems and control efficacy are not on the left-hand branch of the chart, but on the right because the majority of respondents going down the left branch have sufficient labour to monitor the fields.

Figure 2.1 Decision flowchart showing the possible sequence of choices made for deciding between (a) spray until end of spring and (b) routine spray until harvest.



Step four ~ Constraints. This step is imposed on the decision maker for each of the remaining aspects. Some of these aspects may already have been imposed on the decision makers by the scarce resources of previous decisions. These decisions are constraints that they have been unconsciously formulated from existing aspects which render the farmer helpless against the environment. For example, in a situation like the cost of borrowing from a bank; to service his loan the farmer has effectively reduced the resources available for crop production and, therefore, has to plan their usage carefully. In this case, the farmer must formulate 'not sufficient funds' as the constraint.

Step five ~ The decision maker tests the ordered alternatives against the constraints, if no alternative passes all its constraints, the decision maker goes to step six.

Step six ~ A decision maker may follow one of several plausible strategies if no alternative passes all the constraints. They are as follows:

- (a) The decision maker eliminates the ordering aspect first used and returns to step 3 to select another ordering aspect. Steps four and five are repeated.
- (b) If there is still no alternative that passes the constraints, then the threshold on another constraint is lowered. This lowering process continues until at least one alternative passes.
- (c) The decision maker keeps the ordering of the alternatives on the first aspect and simply chooses the highest ranking alternatives on the basis of that aspect. This is a situation similar to what is called a 'trade off' by economists.
- (d) The decision maker decides not to make a decision at time t and searches for new alternatives or waits to see if an alternative can now pass the constraint it failed earlier. This situation may happen in the process of choosing an herbicide at the pre-emergence stage. A farmer who cannot decide at this time may decide to wait until post emergence to see what type of weed is predominant, and choose the appropriate herbicide then.

(iii) Discussion

Stage one of Gladwin's decision making model, which is also Tversky's elimination by aspect model, can be described as a method to set up a feasible way for solving

decision problems, but not for solving the problem itself. In stage one, each individual actor's preferences are likely to be less important than the environmental constraints that determine admissible solutions (Gladwin and Murtagh 1980).

However, it is unlikely that farmers take time to mull over the steps in stage two as described by Gladwin. The simple ordering of aspects is probably all that is needed to make a model correctly predict decision outcomes (Gladwin 1980). Although sometimes there is a requirement to introduce a judgement on a magnitude such as 'X' is more than twice as probable as 'Y', precise calculations of utility magnitude are not likely to be carried out by most farmers. Indeed, there have been long standing debates on the extent by which people are able to estimate utility magnitude and probabilities. Gladwin and Murtagh (1980), argue that Tversky's model makes no allowance for trade-offs and assumes that people can make estimations of the desirability or utility of alternatives and use these estimates to calculate trade-offs.

If people do not make utility or probability calculations, it is argued that they must have been unconsciously following some analogous process with the same result. This 'as if' hypothesis has for a long time been assumed in Neo-classical Economics (Friedman 1968), but experiments conducted in 1950 on probability judgement did not support this view. The experiments consistently demonstrated that people underestimate the probability of very likely events. Furthermore, Gladwin's model does not link decision choices with attitudes. Therefore, the following section reviews attitude models.

2.3 Attitude models

There are many methods for investigating attitudes, some of which are discussed below. However, before getting into these attitudinal methods, the concept of attitude is discussed to clarify what is meant by attitude in this research.

2.3.1 The concept of attitude

Like any term that has evolved gradually from everyday use, the concept of attitude has never been the property of any individual school of thought. It has been flexible enough to accommodate individuals, groups, and whole cultures in relation to precise preferences and to broad views of life (Brannon 1976). The discipline of social psychology views the concept of attitude in a number of ways as there is no agreement among theorists on the precise definition.

Allport (1935) viewed attitudes as a mental and neural state of readiness, organised through experience, exerting a directive or dynamic influence upon the individual response to all objects and situations with which it is related. Brannon (1976) adds that attitudes are also thought of as relatively enduring. That is to say, that they are not necessarily permanent but they do tend to be regarded as fairly stable.

Most theorists agree that the basic evidence for attitude is a pattern of consistency in responses to some social object and although other characteristics like intensity are tapped by some measurement techniques, consistency is still the most preferred and the most convincing evidence for attitudes.

The question of whether attitudes are the tendencies to respond or observed responses then emerges. Allport (1935), Cantril (1946) and Bogartus (1933) have viewed attitude as a readiness to respond which exists in the mind before the response occurs. Some theorists require more than just theory. Horowitz (1944) and DeFleur and Westie (1963) have all objected to any reliance on unobservable quantities, and have argued for a behaviouristic definition based solely on some aspect of observable behaviour. The attitude then is an inferred property of responses, namely their consistency. Stated in another way, attitude is equated with the probability of the recurrence of behaviour forms of a given type and direction.

2.3.2 Attitudes and other concepts

Where should the line be drawn between attitudes and other concepts? What is the difference between attitude and a belief? What is an opinion? These are concepts that are interchangeably used. Theorists like Bem (1970), Berkowitz (1972), Fishbein and Azjen (1972, 1975) are some of those who carefully distinguish between them, although their distinctions are never quite the same.

Harvey, Hunt and Schroder (1961) maintain that opinions, beliefs and attitudes represent increasing degrees of centrality in the personality. Bogartus (1933) stated that opinions are conscious types of beliefs. On the other hand, Osgood, Suci and Tannenbaum (1959) argue that opinions deal with facts, and are verifiable, while attitudes deal with taste and are unverifiable.

Attitudes are argued to have properties that may be viewed as dimensions along which variation is possible, rather than as categorical or defining properties of the concept:

- **Intensity or valence** (Cantril 1946, Hartley and Hartley 1952) refers essentially to the strength with which an attitude is felt.
- **Extremity or magnitude** refers to the nominal content of attitude.
- **Salience** (Stern 1938, Smith et al 1956) is essentially how close to the surface an attitude is. Salient attitudes are those that come most readily to mind.
- **Centrality** (Krech and Krutchfield 1948) refers to an attitudes position in an individual mental universe.

The literature on attitude theory is large and much of it deals with the utility and empirical validity of those abstract concepts (McGuire 1969, Fishbein and Azjen 1972). Yet despite differences, most theorists agree that the basic evidence for attitude is a pattern of consistency in responses to some social objects. Therefore, attitude for this research means a consistency of response to stimuli on some social objects.

2.3.3 The attitude/behaviour relationship

Can attitude predict and/or cause behaviour? What mediates the attitude/ behaviour relationship and how best can one predict behaviour from attitude? These are the fundamental questions according to Cooper and Croyle (1984) who challenged the suggestion that there is a relationship between attitudes and behaviour. However, the following text discusses two perspectives with their respective assumptions followed by models that show the link between attitude and behaviour.

The first perspective assumes that the individuals tend to act in accordance with their attitude. This assumption is regarded by people like Festinger (1957) and Bem (1970) as incorrect, so they propose a reversal process, i.e. experienced behaviour determines attitudes. This view is supported by reviews such as Wicker (1969), which found evidence of a weak relationship between measured attitude and subsequent behaviour. Those in favour of the assumptions that individuals tend to act according to their attitudes such as Ajzen and Fishbein (1980) see low correlations between attitude and behaviour as largely a methodological problem.

The second perspective suggests that on their own, attitudes are often inadequate predictors of behaviour unless mediational variables such as experience, perception, context and goals are taken into account (Fazio and Zanna 1981, Abelson 1982).

2.3.4 The intention model and theory of reasoned action

One model linking attitudes and behaviour is known as the theory of reasoned action proposed by Ajzen and Fishbein (1980). This focuses on behavioural intention. An intention according to them, is a function of two components, namely a person's attitude towards performing a specific behaviour and a subjective view of the social norms regarding that behaviour. The measurement of intentions, it is argued, permits the near-perfect predictability of the corresponding behaviour. Other investigators like

Davidson and Jaccard (1979) have also found high correlations between intentions and subsequent behaviour.

Fishbein and Ajzen (1975) based their theory of reasoned action on the assumption that human beings are usually quite rational and make systematic use of information available to them. Fishbein and Ajzen reject the suggestion that human social behaviour is controlled by unconscious or overpowering desires or can be characterised as thoughtless or malicious.

The first step of their approach in predicting and understanding an individual's behaviour is to identify and measure the behaviour that is of interest. Once this is established it is then possible to ask what factors determine the particular behaviour. By assuming that social behaviours are mostly under volitional control, the theory suggests that an individual's intention to perform, or not to perform, a behaviour is the immediate determinant of the action. The theory does not however suggest that there will always be a perfect correspondence between behaviour and intentions but, unless there are unforeseen events, an individual will usually act in accordance with his or her intentions.

Since the notion that intentions predict behaviour does not provide much information about the reason for behaviour, the theory of reasoned action also offers a means for behaviour analysis. To do this analysis, it is necessary to start by identifying the determinants of intention. According to this approach, a person's intention is a function of two basic determinants, namely a personal factor and a factor which reflects social influence. The personal factor is an individual's positive or negative evaluation of performing the behaviour in question; this is termed the attitude towards the behaviour.

It is generally accepted amongst attitudinal investigators that attitudes towards any object are determined by a person's beliefs about the object. Through life experience an individual forms his/her beliefs about various objects, action and events. According to Fishbein and Azjen, these beliefs may be formed as a result of direct observation or indirectly acquired through information received from external sources. Some beliefs may be dropped while others may persist over a period of time or new ones formed when new information received warrants them. An individual can only attend to a relatively small number of beliefs at any one time - approximately five to nine (Fishbein and Azjen 1975). These small number of beliefs or salient beliefs, according to the theory of reasoned action, are the immediate determinants of an individual attitude.

The second determinant of intention is the individual perception of the social pressures on the individual to perform or not to perform the behaviour in question. This is termed the subjective norm or normative belief. Thus, a farmer may respond to what his advisor, wife, customers etc. think he has to do to protect his crop.

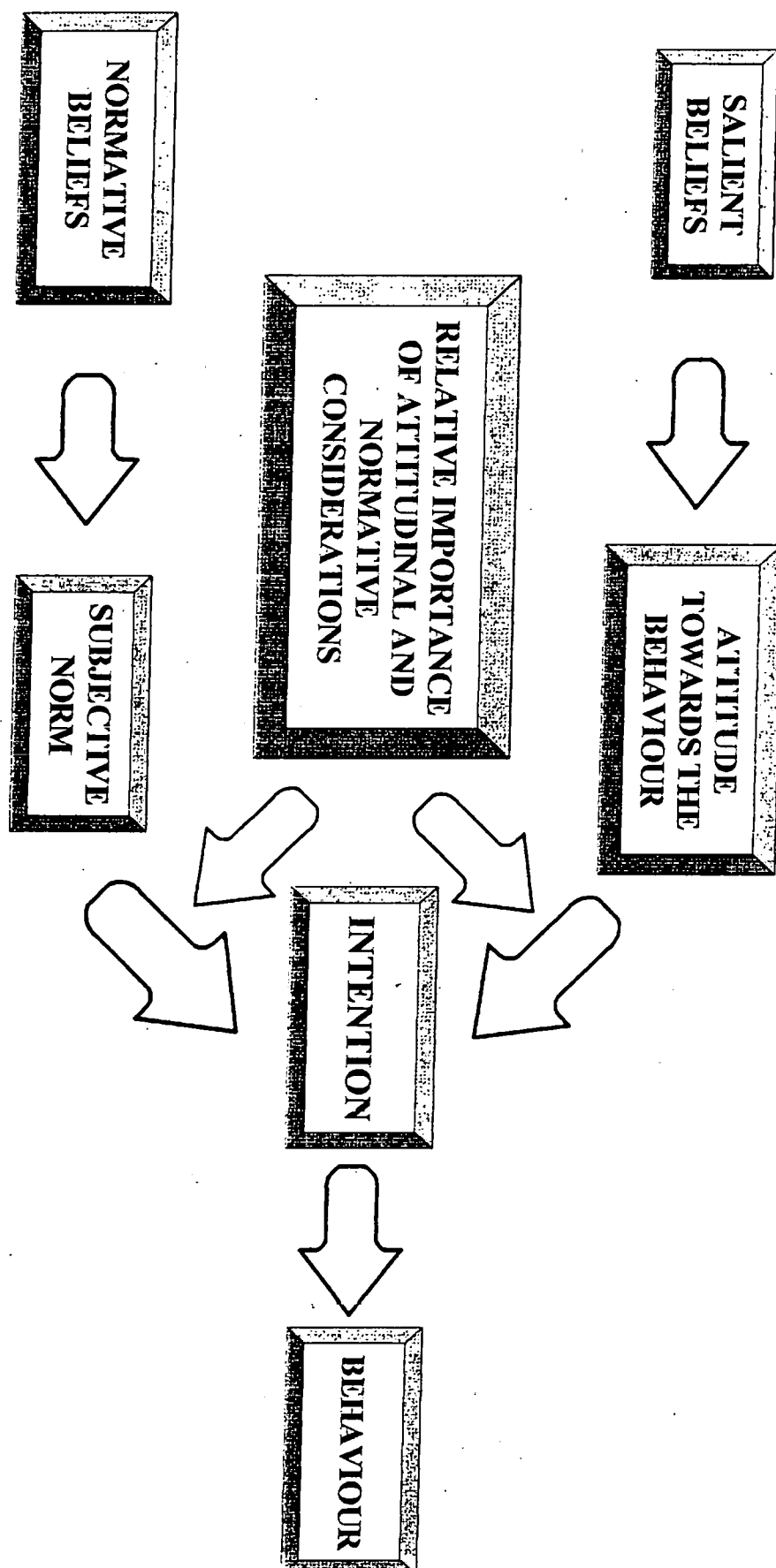
Thus, as a general rule individuals will usually intend to perform a behaviour when they assess it positively and when they believe those they listen to think they should perform the behaviour. However, if conflicts exist between the attitudes towards behaviour and the subjective norms, it is then necessary to know the relative importance of the attitudinal and normative factors as determinants of intention. The theory of reasoned action assumes that the relative importance of these factors depends in part on the intention under investigation. There are intentions where attitudinal considerations are more important than the normative considerations. The converse also holds. However, often both factors are important determinants of the intention. Furthermore, the relative weights of attitudinal and normative factors may vary from one person to another.

According to this approach, the assignment of the relative weights of the determinants of intention greatly increases the explanatory value of the approach. For example, suppose one farmer intends to use pesticide as prescribed by his advisors while another would use the chemicals when he deems it to be necessary, but that the two farmers have identical attitudes and subjective norms towards the use of chemicals in their crop protection strategy. Their differing behaviour would result if the first farmer's intention was determined primarily by his subjective norm and the second farmer's intention was determined primarily by his attitudinal consideration. The essence of this model is summarised in Figure 2.2.

2.4 Discussion

This chapter has reviewed some major models relating to decision making and the influence of attitudes, all the while trying to give possible crop protection examples of each. This discussion summarises their features and indicates which was tested in this research.

Figure 2.2 Factors determining a person's behaviour according to the theory of reasoned action (Fishbein and Azjen 1975).



The dissonance model enables the analyst to find explanations of peoples' choices and to understand the conflict which has arisen while the choice was being made. This theory can also be used to predict an individual behaviour by assuming that the individual will always strive towards consistency of beliefs with behaviour within him or herself. This involves a process of reducing in magnitude the dissonance within the individual, in order to improve the attractiveness of an alternative. The problem here is that this process of reduction often appears unrealistic. For example a group of farmers who prefer to spray until harvest time would not be increasing the attractiveness of the alternative, namely to spray until spring, if pest infestations have been high in previous years.

The normative approach predicts an individual's behaviour by basing the individual's decision making process on the individual's desire to maximise goal attainment. The weakness of this approach is that it does not include the risk element in its equation i.e. it does not separate this element from the uncertainty element and we do not always know what the goals are.

The anthropological approach incorporates the distinction between risk and uncertainty into a theory relating the adoption of behaviour to its impact on economic status. This theory seems to imply that the smaller holdings would be more willing to experiment with new innovations as they could not sink lower in their economic status. This situation is not often found on farms as smaller holdings do not possess the resources to try any novel technology and are unlikely to do so unless their behaviour could be assured of higher returns.

The elimination by aspect model suggests that the decision maker eliminates undesirable alternatives when making a decision. The alternative chosen must be acceptable on all aspects. This was regarded as too simplistic to explain farmer decision

making. The real life choice model is a more elaborate version of the elimination by aspects model. Like Tversky's approach Gladwin's model is capable of modelling decision problems but it does not solve the problem itself. The ordering of aspects in Gladwin's method is so complex that it is unlikely that farmers take time to mull over the various steps described by Gladwin.

While decision making models are useful for understanding decision making processes, many make no provision for a method to test the various steps of the models, particularly Gladwin's model. Furthermore, they are not designed to link attitude to behaviour. Some attitude models like the Fishbein and Ajzen model have such provisions and have been previously used to study farmer decision making (Tait 1983, Carr 1988) and in particular crop protection decisions. It was therefore decided to use this model to understand farmers' decisions and the influence of information systems. The next step was to select a study area and undertake a preliminary survey before testing this model in full.

Chapter 3 A review of the study area (West Sussex) and the methods used to do a first, preliminary, survey of farmers

3.1 *The study area*

3.1.1 Introduction

West Sussex was selected as the area for field work for the research because it is a reasonably typical arable area where the diversity of conditions may provide differences in farmers attitudes, as explained below, and which was within reasonable travelling distance.

The location of Sussex along the coast of Southern Britain provides a mild climate that is, in general, ideal for successful farming. Indeed, an arable economy has been in existence in this area since the early bronze age (Salzman 1905). However, variations in climate between the coastal and the inland areas exist, and this, combined with the varied geology, relief, and soils occurring in the county, produces varied farming conditions. Some areas have a very high agricultural value, others a marginal value, while some areas have such poor soil that farming for commercial purposes is not possible.

3.1.2 The types of soils

Large areas of the South Downs in West Sussex are covered by the Andover Association (Figure 3.1). These soils are invariably flinty and chalky silty brown redzinas over chalk. They are well drained. They are easy to work after rain, but dry rapidly in spring. They can be cultivated and are well suited to minimum cultivation techniques (Cope 1976). The majority of the land is under continuous cereals, or cereals in rotation but land use will be described in full in section 3.3.

The Blewbury series (Findlay 1976) are typically brown calcareous earths and clayey over lichoskeletal chalk. The soils are naturally well drained and thus slightly droughty

for cereals. There are long periods during the autumn when the soils can be safely worked but only a few suitable days in spring. The land is used predominantly for cereal and grass crops. To avoid poor ground condition in spring, most cereal crops are sown in the autumn.

The Bignor Association is a fertile, loamy grey siliceous soil, mostly with impeded drainage. These soils hold large amounts of available water, but arable crops are likely to suffer some drought in most years. However, the main soils are moderately easy to cultivate and there are plenty of opportunities for autumn tillage. Time is however important because of the danger of damage to weak top soil structure. Fine seed beds are liable to slake and cap after heavy rain. Most farms with these soils carry cereals and dairy beef.

The Frillford Association soils are brown, stone free permeable and well drained (Findlay 1976). These soils are easy to work and there are long periods in the autumn and spring when land can be worked. The droughtiness of these soils makes them more suitable for cereals than a grass crop.

3.1.3 Changes in agricultural land use

In the last three decades agriculture in Sussex has seen considerable changes. These changes reflect both developments that have happened nationally in British agriculture during the same period, primarily the effects of UK entry into the European Community (EC), and those that are more specific to south east England with its relatively prosperous and mobile population. The impact in Sussex has been varied, but the most noticeable change has been the increase of the ploughed area; less obvious are changes in the size and structure of farm enterprises: in farm labour, in mechanization and in the relative importance of different crops and livestock (Anon 1992).

Despite the changes, the total area of actively managed agricultural land in the country has remained stable over the last three decades. The West Sussex land use survey of 1971-81 showed that in 1971 some 126,170 hectares in the area were covered by arable and grassland which accounts for 63% of the total country area. By 1981, the total area had only increased to 127,908 hectares or 63.3% of the country area, a figure that is largely unchanged in the MAFF (Ministry of Agriculture, Fisheries and Food) figure in 1991 of 126,576 hectares of agricultural land (MAFF 1992).

The small increase in agricultural land between 1971-81 was largely caused by the conversion of other open land uses to agriculture. This offset the losses of 2,000 hectares of agricultural land to building development programmes, which probably continued throughout the 1980s. These losses have been borne mostly by areas around the coastal plain (1.9%) and the low weald (1.5%). There have been only very small changes in the South Downs and the high weald in terms of net agricultural area.

Arable lands, both cropped and fallow, represented about 40% of the total agricultural area in 1991. This has remained unchanged since 1976 and is in line with the regional and national trends. However, the sub county areas showed wider variations. The highest concentrations of cropped areas are around the coastal plain and the South Downs, with increases of 2 and 9.3 percent respectively over the period 1976-1991 (MAFF 1992). Grassland, like the regional and national trend, has declined over the same period, particularly on the coastal plain and the South Downs area. This is due partly to conversion to arable land. The coastal plain saw dramatic increases in oilseed rape acreage while wheat production on the South Downs has increased over the period by over 50%. In other areas of the country there have been increases over the period in permanent pasture, sheep and lambs.

3.1.4 The sizes of holdings

In 1991 there were 2,325 main holdings recorded in West Sussex (MAFF 1992), an increase of 8.7% since 1976; yet in spite of the increase there were only 553 holdings or 23.8% over 50 hectares. There has thus been a shift towards smaller size holdings, pointing to progressive fragmentation. Part time holdings have increased by 28% over the period 1976-1991. Farm owners with interests and income outside agriculture may be contributing towards the increase. The number of part time holdings are relatively small compared to the rest of the county, but they have increased substantially since 1976.

The South Downs area has not followed the overall trend in the county, as 60% of the holdings recorded are over 50 hectares. Conversely, on the Coastal Plain, 80% of the holdings are less than 50 hectares. These two areas in 1991 showed the lowest level of owner occupation recorded, which means that a high proportion of the agricultural land in these two areas of West Sussex was rented land.

3.1.5. The agricultural labour force

There was an overall decline in the agricultural labour force of 10% between 1976 and 1991. The loss of these workers was particularly significant in the family worker category where some 90% losses were recorded for both full-time and part-time workers. However, this is offset by the increase in the number of spouses of the main farmer or partner working for the farm. In the South Downs there were increases in the numbers of salaried farm managers in the larger arable holdings.

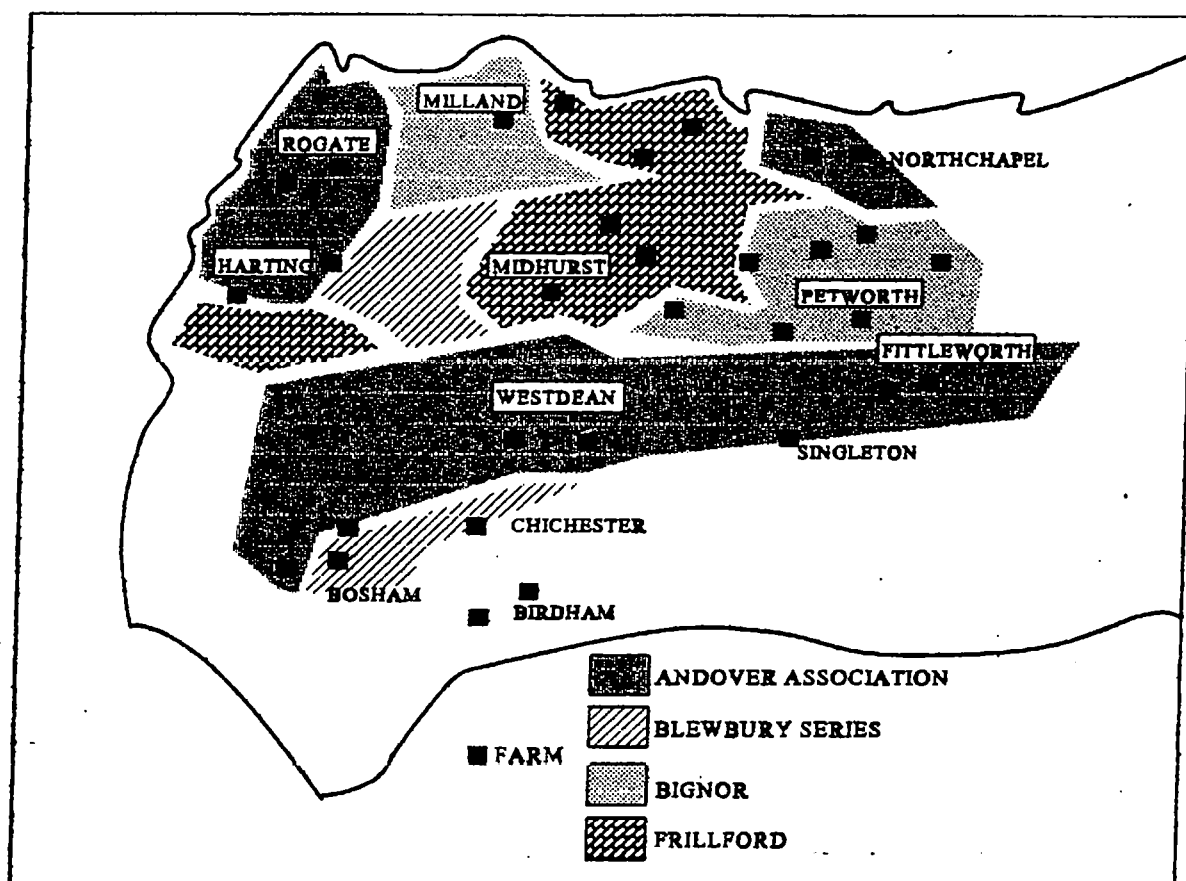
3.2 *Aims and methods for the first, preliminary, survey*

The aim of this first survey was to recruit respondents from a sample of coastal plain and Down farmers in West Sussex who were representative of the overall cereal farmer population and to gain an initial view of their farming systems and their attitudes and activities. To qualify, the respondents had to have the following attributes:

- (a) The farmer must farm 20 hectares or more to ensure that the size of the holding was sufficient to produce output for commercial purposes, i.e. not growing food just to feed animals on the farm. Therefore the crop would be a valuable asset for the farmer, particularly where legislation or market demands caused the market value of the crop to rise.
- (b) The crop selected was winter wheat; so the farmer should be growing this crop in his fields or some of his fields. The reason winter wheat was selected was because it was, and still is, the most common arable crop grown in the area. Winter wheat production is longer than spring sown wheat, thus it has provided a longer observation time on farmers behaviour than if spring sown wheat had been selected.
- (c) Wherever possible, they should have a range of soil types; the reason for this was to see if the diversity of the physical conditions of the fields resulted in different attitudes.
- (d) The respondent should be the principle decision maker (or jointly responsible with another person).
- (e) Where respondents agreed to be contacted face to face or by phone, they should be prepared to commit themselves to interviews at agreed times after the initial postal questionnaire was completed. For those who preferred to be contacted by mail they should be prepared to complete the questionnaire and return them in the stamped, addressed envelopes provided.

To find the candidates, lists of farmers from local NFU branches were obtained, and also names recommended by friends and acquaintances. After selecting potential respondents using the sampling procedure above, thirty-seven farmers were contacted. The majority (31 out of the 37 contacted) returned the questionnaire sent to them. The locations of these farms are marked on the map (Figure 3.1)

Figure 3.1 Map showing the position of the farms surveyed and the soil types in the study area (not to scale).



The respondents were sent questionnaires to complete pre-sowing i.e. over the summer. This questionnaire asked for information on:

- (i) Ownership status of the farm (owner/tenant).
- (ii) Size of fields.
- (iii) Type of farm (mixed or cereals)
- (vi) Number of employees.
- (v) Sources of information on crop protection.
- (vi) Important person(s) or group(s) that would influence their decisions.
- (vii) Types of pests* which can seriously affect wheat yields.
- (viii) System of pest control used on wheat.

- (ix) Value of crops grown.
- (x) Farmers forecast of the weather for the growing season.
- (xi) What pesticides would be used.

(see Appendix 1 for the full questionnaire)

* N.B. Here the term pest denotes all organisms noxious to the crop.

Once the questionnaires had been returned, the respondents were grouped according to the size of their farms, the system of crop protection they employed and their sources of information. When groupings had been completed, the respondents' crop protection behaviour throughout the growing season was then followed to see if external information sources influenced their perceptions of likely pest attacks.

The farmers were contacted by mail or telephone or face to face twice before the end of spring and again in June at the time when aphids (the most likely and damaging pest) could infest the crop. On each occasion they were asked about the status of their fields with regard to pests, what potential problems with infestations they expected to occur, what they thought the weather would be by harvest time (i.e. mainly dry, unsettled etc.), and finally whether their crop protection intention was still as stated at pre-sowing time.

Other information with regard to the respondents' background (which in this case refers to educational history and upbringing) was also obtained either by phone, face to face, or by mail. It was rather difficult to come to a conclusion on the respondents' background for those who preferred to be contacted by mail only, however, their numbers were not large (three only). The only clue that had partly given a picture on respondents' background was from the way answers were constructed. It was easier to

get information on respondents' background face-to-face or on the phone as digressions from the original questions were possible.

Information such as the person(s)/group(s) who were important to the respondents was used in the questionnaires in the second survey (see Chapter 6). Information on crop protection practices formed the basis of the research. The other information, such as size of holdings, pests, was used in an analysis of factors influencing attitudes and, ultimately, behaviour.

Chapter 4 Results and analysis of the first, preliminary, survey

4.1 Survey results

4.1.1 Respondents' background

As mentioned in Chapter 3, one criterion for selecting a respondent was that he/she must be the major decision maker. The 31 farmers surveyed were all relatively well informed, many had been to agricultural college and most had many years farming experience (2 farmers less than 5 years, 9 farmers between 5 and 10 years, 16 farmers between 10 and 20 years and 4 farmers more than 20 years experience). They were all male. There were no female farmers in the decision making category for winter wheat production available in West Sussex.

4.1.2 Size of farms

Only one of the 31 farmers had a farm over 200 hectares. Eleven farms were between 100 and 200 hectares; the remaining 19 were between 20 and 100 hectares in size.

4.1.3 Ownership status

Three of the largest farms belonged to food producing companies and were run by managers. Seven were privately owned and managed by local farming families. Two of the largest farms were privately owned and managed by managers. The rest (19) were tenant farmers.

4.1.4 Perceived pest problems

The results from the initial postal questionnaire sent indicated that the following pests were those considered likely to cause yield losses in winter wheat:

a) Weeds. Grass weeds were the major problem afflicting all types of soil, in particular blackgrass (*Alopecurus myosuroides*). All 31 farmers reported problems with blackgrass.

b) Fungal diseases. Mildew (*Erysiphe graminis*) and Eyespot (*Pseudocercospora herpotrichoides*) were the most common disease problems mentioned. Twenty-five farmers reported problems with both types of fungal diseases.

c) Insect pests. Grain aphid (*Sitobion avenae*). Sixteen out of thirty-one had experience with field infestations by this type of aphid. Eleven of them had fields with continuous cereals.

d) Slugs. Only those with clayey fields (6 respondents) had problems with slugs.

e) Deer. Farms around Midhurst, Rogate, and Petworth are surrounded by woodlands. Respondents with farms in these areas reported problems with deer.

Although 'pests' encompassed all the above, most farmers only considered fungal diseases and insect pests when identifying possible crop damage as reported in Table 4.1. This table highlights that farmers with larger fields, and possibly more money at stake, were more likely to rate the chance of pest attack as high.

Table 4.1 Perception of losses from pest attacks by farmers, by area of wheat cropped, of those involved in the first survey (N.B. not all farmers responded).

Farmers estimate of likelihood of severe losses	Farms with less than 80 ha.	Farms with between 80 and 160 ha.	Farms with between 160 and 240 ha.	Farms with more than 240 ha.
Maybe	3	-	-	-
Likely	-	16	-	-
Very likely	-	-	2	1

In addition to the likelihood of pest damage, farmers were asked to give the most likely reasons why they had suffered, or might suffer, such pest attack (Table 4.2). Poor husbandry was one of the main reasons given and relates mostly to weed problems, but otherwise 'good' weather conditions and pest resistance seem to have been the main contributory factors in the eyes of the farmers.

Table 4.2 Perceived reasons for suffering pest attack as noted by farmers in the first survey.

Reason	Farms with less than 80 ha. of wheat	Farms with between 80 and 160 ha. of wheat	Farms with between 160 and 240 ha. of wheat	Farms with more than 240 ha. of wheat
Poor husbandry	3	14	-	-
Unexpected weather favoured pests	3	25	2	1
New breed of resistant pests	-	17	2	1
Insufficient applications of pesticides	-	3	2	1

4.1.5 Crop protection

The experience respondents had with the above mentioned pest and disease problems was reflected in their use of agrochemicals as shown in Table 4.3.

Table 4.3 Use of agrochemicals by the farmers in the first survey.

Type of agrochemical used for pest control	No. of users (n = 31)	Modal no. applications/ season (Range 1-7)
Broadleaf weedkiller	31	4
Grass killers	31	4
Soil insecticides	9	1
Brush killers	18	1
Crop insecticides	31	3
Fungicides	31	3

As can be seen, broadleaf weed and grass killers were the most frequently applied agrochemicals followed by insecticides and fungicides

At the beginning of the season, twenty-six respondents said they intended to apply pesticides five times during the season until near harvest time, while four intended to spray seven times. These figures remained unchanged when the respondents were contacted in the following January. However, by April all twenty-six of the respondents who intended to spray five times had already completed their spraying programme, and had only sprayed three times in the season. Two out of the four who intended to spray seven times, completed their spraying in May, and had sprayed only five times. The other two sprayed the number of times they had intended. Thus intention did not match behaviour in most cases.

There were nearly an equal number of farms per soil type. There were no indications of differences in intention and actual application of agrochemicals among farmers of different soil type associations.

4.1.6 Sources of information

Respondents listed the following as their sources of information: ADAS, independent advisors, merchant advisors, manufacturers' advisors, magazines, leaflets, and an NFU newsletter. When the advisors were analysed by area of wheat grown it was found that farmers with a larger area of wheat were more likely to employ an independent advisor rather than a commercial one (Table 4.4). Sources of information are discussed more fully in Chapter 6.

Table 4.4 Type of advisors used by farmers according to the size of their wheat crop.

Type of advisor	Farms with less than 80 ha. of wheat	Farms with between 80 and 160 ha. of wheat	Farms with between 160 and 240 ha. of wheat	Farms with more than 240 ha. of wheat
Independent	-	3	3	1
Commercial	2	22	2	-

4.1.7 Employees

It was found that farms with a larger area of wheat employed more people (Table 4.5).

Table 4.5 Number of employees according to size of wheat crop

Number of employees	Farms with less than 80 ha. of wheat	Farms with between 80 and 160 ha. of wheat	Farms with between 160 and 240 ha. of wheat	Farms with more than 240 ha. of wheat
None	3	15	-	-
One to five	-	8	4	-
More than five	-	-	-	1

4.2 *Discussion of initial results*

The previous section has outlined the changes in agricultural land use in West Sussex and described the surveyed farmers' backgrounds and pest control perceptions and actions. Pest problems varied. Grass weed problems have been persistent and on the increase. Research into the population dynamics of blackgrass (Moss 1980) has identified factors that influence the build up and decline of populations. Viable seeds are found to decline in cultivated soils suggesting that the continued presence of these grass weeds in the surveyed farms was probably due to inadequate control, allowing new seeds to add to existing resources, rather than to the persistence of seeds in the soil. Furthermore, paraquat, the herbicide that made possible the practice of direct tilling or no till, has reduced the requirement for soil cultivation. This, coupled with the decline of people working in the agriculture industry, may be the reason the black grass problem has been on the increase.

There was also another factor that may have contributed to the problems of black grass and fungal diseases, namely the prohibition of stubble burning by the government. In the past, stubble burning helped the seeds of black grass to germinate and thus made them easy to destroy with herbicide, while spores of fungal diseases remain on debris

and unburnt stubble after harvest and throughout the winter, so infecting new crops again in the Spring with the rise in temperature. The farmers surveyed expressed annoyance over the prohibition of stubble burning, as they regarded this as a contributory factor to the problems with weeds and fungal diseases.

Aphids, which spend all stages of their life cycle on grasses and cereals, are most numerous in June. However, all but two farmers had ceased to spray before June. When questioned about this, the majority simply stated that it was their judgement that the aphids that live in grass and cereals had been sufficiently controlled by the three sprays. There were discrepancies between the intention and the actual numbers of sprays of agrochemicals. This discrepancy was deemed worthy of further investigation and is analysed further in the next section.

4.3 *Further analysis of the preliminary survey: a systems study*

4.3.1 Introduction

The unexpected outcome of the preliminary survey, that farmers sprayed fewer times than intended, is analysed here, to understand how to investigate further the system for crop protection. The methodology used is systems analysis (Open University 1984). The concept of a system is regarded as an essential tool for the analysis of decision problems, failures or messes and it provides a way to study what one perceives to be relevant in the world as well as a way to formally represent and test one's findings.

There are several systems approaches or methodologies. Three of the most widely used are the Failures method, the Hard Systems method (HSM) and the Soft Systems Method (SSM) (Open University 1984). To choose which of these methods to use is not that simple. They are suited to different types of problem situations and expect a different relationship between the analyst and the system being studied (Table 4.6).

The next step was to determine the role or the degree of involvement of the analyst in the situation. The analyst in this case was an observer rather than a problem solver for a client; nor was the analyst a facilitator in a conflict of perceptions, aspirations etc. (Table 4.6). This suggests that the appropriate analytical approach to use in this case is the Failures method.

The Failures methodology offers the analyst the role as a detached diagnostician providing explanations for the problem situation. When the analysis has been completed, the failures methodology also enables further investigation using other non-systemic methods as discussed in Chapter 2.

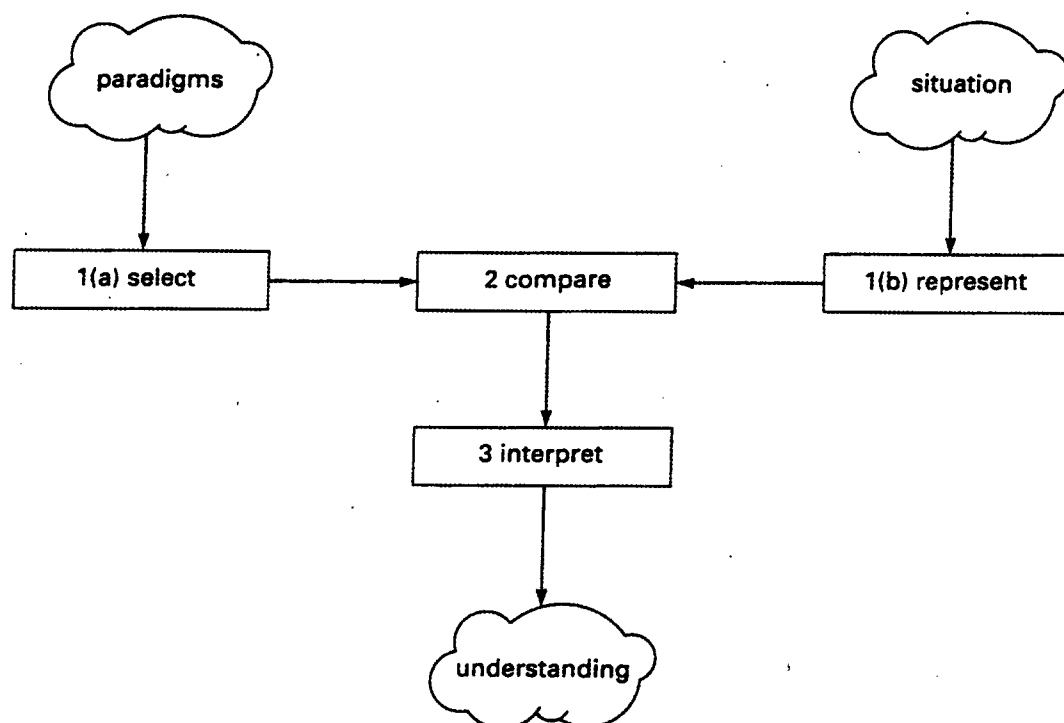
Table 4.6: Differences in the client/analyst relationship for the 3 main systems methodologies.

Failures Method	Hard Systems Method	Soft Systems Method
1. The approach makes no special provision for an analyst to work for a client.	1. There can be separation between analyst and client. The initial problem perceiver is often the problem solver, but the problem solving is often contracted to an analyst. The client's involvement informal rather than full time.	1. Role of analyst is that of a counsellor, facilitator. An analyst has to mediate between relevant members of the organisation to help them develop a shared view and to discuss appropriate action constructively.
2. An analyst has the role of a commentator or a diagnostician conducting an independent, intellectual and investigative inquiry from an outsider's viewpoint, that is insightful for the client and wider audience.	2. The formal role of a client is to realise the existence of a problem and need to select an analyst. Client negotiates task conditions and problem definition and eventually receives and acts on the analyst's recommendations.	2. Subcontracting to an analyst makes problem solving time-consuming due to problem based learning process.
3. The key relation is with all participants rather than with any client.		

4.3.2. The Failures method

This method is briefly summarised below and also shown in Figure 4.1 (see also Open University 1984, Bignell and Fortune 1985).

Figure 4.1 A diagrammatic representation of the stages in the Failures method (Open University 1984)



Stage 1: To gain an understanding of a complicated and confusing situation, a method for systems description is used to represent the system(s) involved diagrammatically through systems maps, at the same time as selecting relevant paradigms (or ideal systems models) to help identify the possible areas where surprising or failed results have occurred.

Stage 2: The next stage is to attempt to find a fit between each paradigm and the corresponding components of the 'failure situation'. In other words the system(s) is/(are) compared with a number of ideal systems models or paradigms.

Stage 3: Discrepancies resulting from the comparison can then be identified in order to interpret the failures in the system..

4.3.3 Systems analysis of the first survey results: selecting paradigms and representing the situation

The paradigms chosen for this analysis, and the reasons for using them, were:

(i) The Formal System Paradigm (Open University 1984). This paradigm is an idealised version of what any human activity system should be. It was used to establish whether or not the crop protection system follows the definition of a system during the growing season. If not, how and where does it differ?

(ii) The Social Group Paradigm (Sudbury 1988). These are groupings of people or organisations with common interests that can cause the system to change. It could be a positive change, e.g. the prevention of failures or shortfalls, or a negative change which will be one of the causes of failures or unexpected situations. Legislators, merchants, the work force, advisors etc., were all social groups which could change the behaviour

of the system, hence the choice of this paradigm in looking into the behaviour of these groups.

(iii) Profit maximisation paradigm (Sudbury 1988). This paradigm describes how companies, or groups of people or holdings may be engaged in activities that help them achieve short term goals, but give long term problems. These problems can be financial, social, or environmental problems. As the production of winter wheat was ultimately to make a living for the producers, and they needed to ensure that their return was above break even point, the profit maximisation paradigm was relevant for comparison in this case.

(iv) Control paradigm (Open University 1984). This means there is an action which a system or subsystem applies to its own activities in order to reach or maintain a desirable state. In producing the crop, control of pests and diseases was important. Depending on the individual farmer, action on control may also be driven by the need to make greater returns.

Having identified some appropriate paradigms it was then necessary to identify systems of interest to compare them with, which in this case are the crop protection decision making systems of the farmers being surveyed. Drawing upon the information gathered in the first survey and through other contacts with the farmers, spray diagrams were drawn to highlight the relationship of the decision maker with advisors and other groups and to show areas which changed throughout the growing season. Because there were changes, drawing boundaries on these diagrams was not easy and these sometimes had to be made mobile boundaries to reflect the dynamic nature of the system. The farmers were finally grouped into three grouping on the basis of the crop protection system that suited their particular needs:

- Group A which represented 17 farmers who owned and/or managed the farm and were themselves the decision maker, and who largely excluded the advisor from the decision making process.
- Group B were 11 farmers who included their advisors in their decision making process.
- Group C contained just 3 farmers who left their crop protection decision making to their advisors.

Not only was there a similarity between the farmers within a group in their use or non-use of an advisor, farmers within a group were also similar in their initial spray intentions. It was therefore considered that these were reasonable groupings for this analysis, although it was recognised that not all farmers within a given group are necessarily similar in other respects.

The systems maps in Figures 4.2 to 4.5 represent the different crop protection systems for the three groups mentioned above. Each map is a model of the relationship of the decision making sub-system with other sub-systems as well as interactions with external influences.

Figures 4.2 and 4.3 are models for group A. They show that the boundary of the system moved within the season, due mainly to the exclusion of the advisor as a component. Figure 4.2 shows group A during the period October 1991 - April 1992. The agrochemical manufacturers system and chemical retail system are both overlapping the wider system boundary, indicating that both were initially involved in the crop protection system for that period. Figure 4.3 shows the crop protection system for group A during the period April 1992 - August 1992. The map shows that the boundary has moved, leaving both the agrochemical manufacturers system and chemical retail system in the environment, advisors are no longer within the decision making sub system for those farmers.

Figure 4.2 A systems map for group A for the period October 1991 to March 1992.

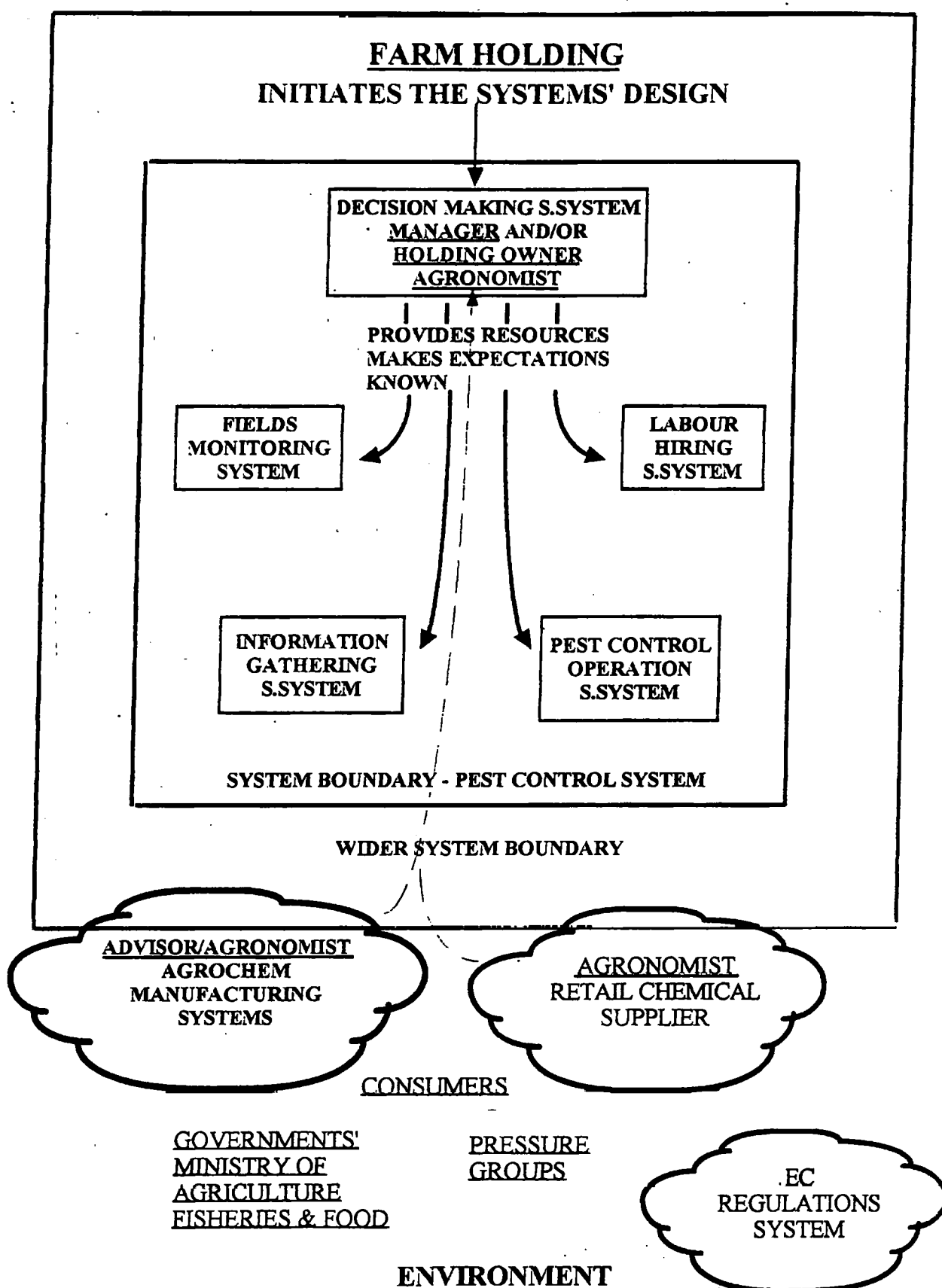


Figure 4.3 A systems map for group A for the period April 1992 to August 1992.

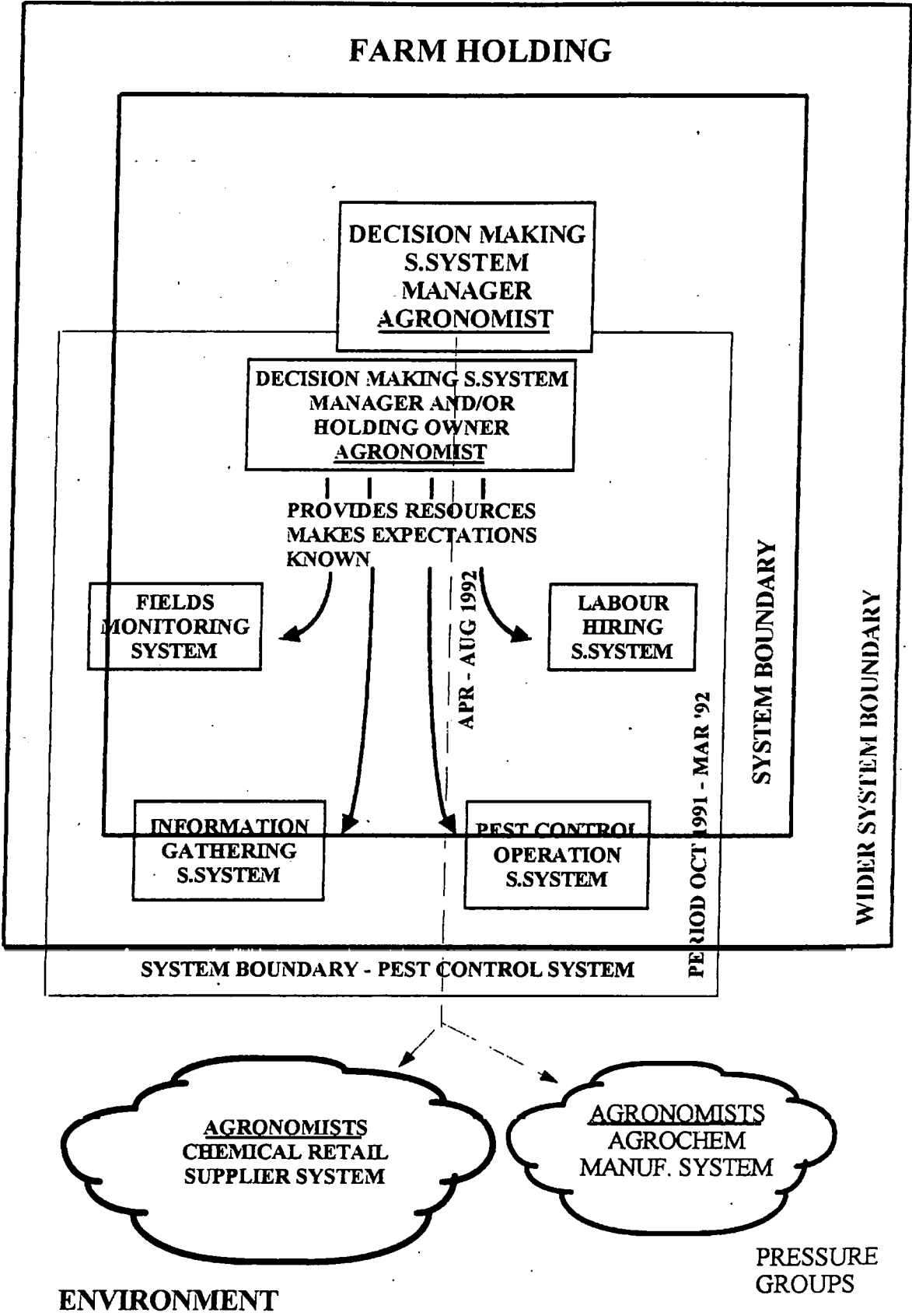


Figure 4.4 A systems map for group B.

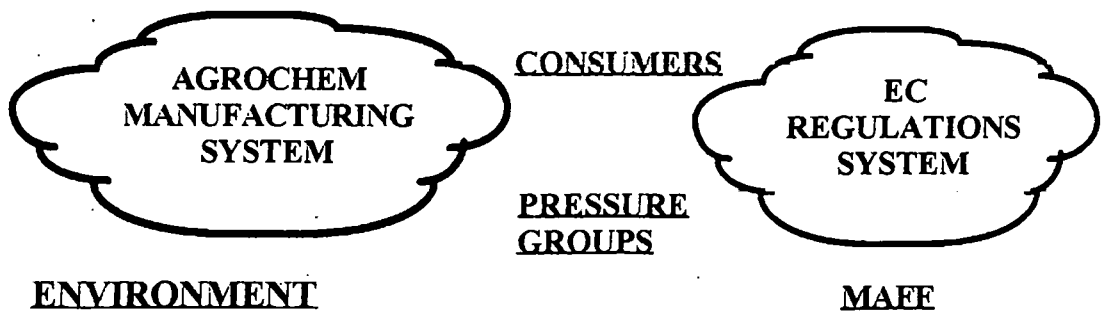
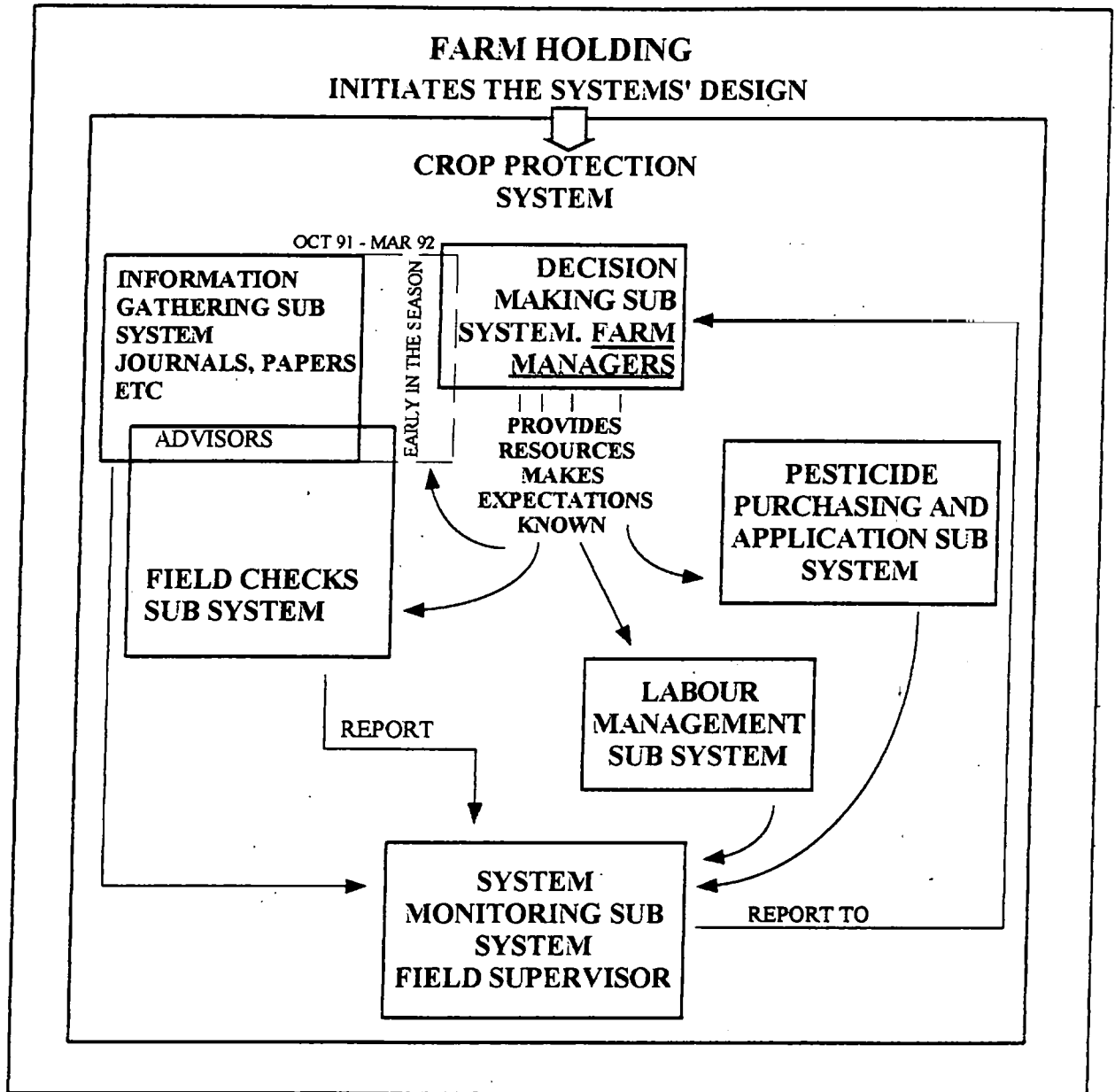


Figure 4.5 A systems map for group C.

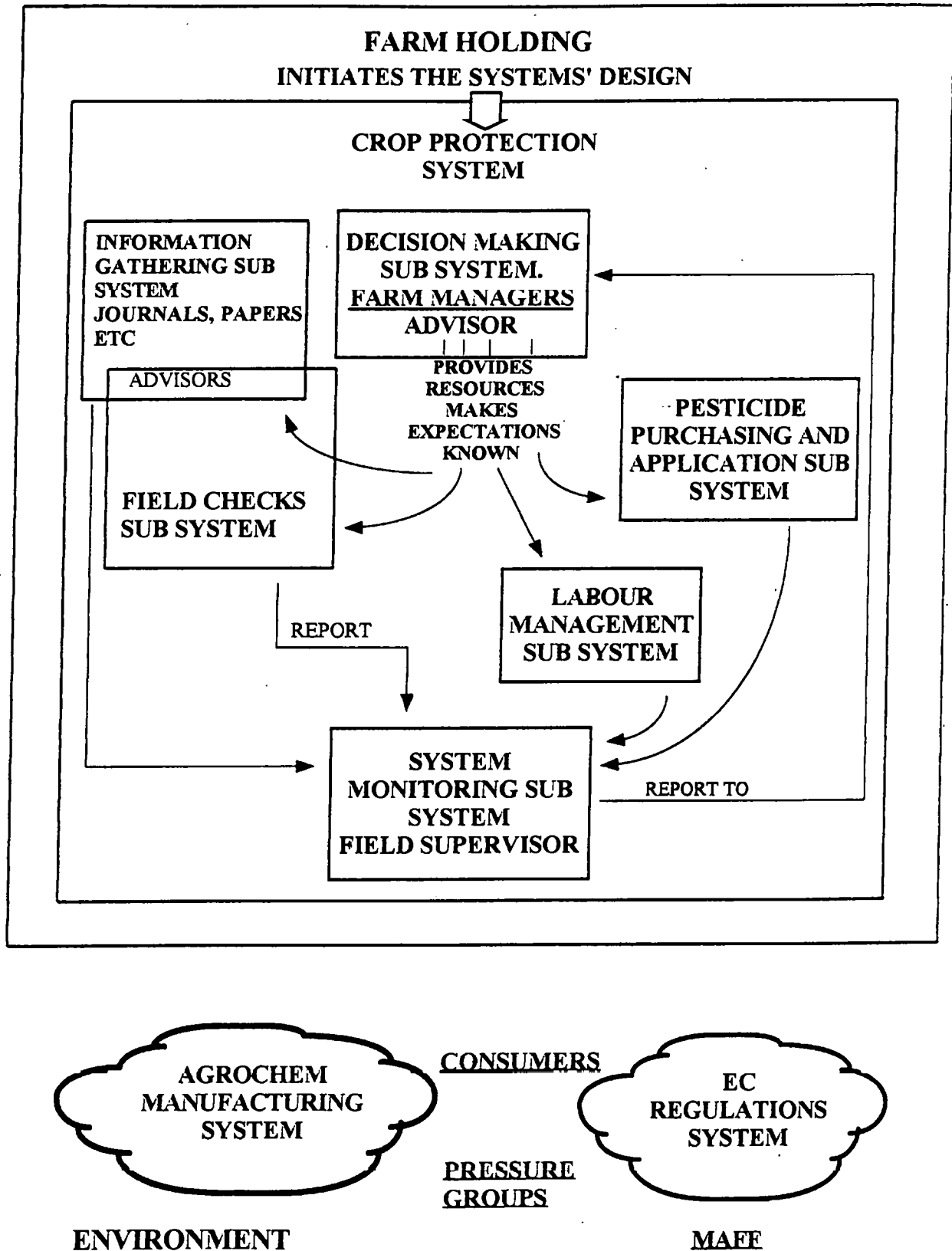


Figure 4.4 shows the model for crop protection system of group B. This model shows that advisors were always included within the boundary of the crop protection system. This may be explained by assuming that this group of farmers valued the services of the advisor in a way that Group A did not. Whereas for Group A the advisors role seems to have been to give a certain idea on how to protect their crop at the beginning of the season, the advisors role in Group B went further, starting with them as part of the decision making sub-system and later becoming part of the information gathering sub-system, which itself overlapped with the field check sub-system, and which provided information for the decision making sub-system.

Figure 4.5 shows the crop protection system for group C. It did not change throughout the whole season. As such, it was not a dynamic system.

4.3.4 Systems analysis of the first survey results: comparison of systems with paradigms

The areas judged as having problems in the systems described above were compared to the list of paradigms. In comparing these problem areas with the paradigms discrepancies were identified as described in stages 2 and 3 of the Failures method. These discrepancies were then tabulated as shown in Tables 4.7, 4.8 and 4.9.

Table 4.7: Comparison of system with paradigms for group A: Owner and managers who are the decision makers throughout the growing season.

Area under observation.	Unexpected and/ or failure situations.	Paradigms used for comparison.
1. Weeds and grass infestation	Problem has become worse over the years	Control Paradigm Social Group Paradigm
2. Labour availability	Decreases	Social Group
3. Pest control method	Some form of risk management by ceasing to apply pesticide in April/ May	Social Group Profit Maximisation.
4. Chemical dependency	Vary, depending on actual situation. Sometimes leading to losses when control measures were not correctly taken	Social Group Control Paradigm
5. Decision making process	The function of the advisor varies with time of season	Formal System

Table 4.8: Comparison of system with paradigms for group B: where advisors partially participated in the crop protection decision making.

Area under observation	Unexpected and/or failure situations	Paradigm(s) used for comparison
1. Weeds and grass infestation	Problem persists	Control Paradigm Social Group Paradigm
2. Pest control method	Ceasing application in May, as in cluster A	Social Group
3. Decision making process	Early during the crop life, decision making percentage 65% advisor, 35% Manager	Control Paradigm Social Group Profit Maximisation
3. Decision making process	Later during crop life, the decision making percentage shifts occur: 70% Manager, 30% Advisor	Social Group

Table 4.9: Comparison of system with paradigms for group C: where advisors were allowed to make the majority of the pest control decisions.

Area under observation	Unexpected and/or failures situation	Paradigms used for comparison
1. Weeds, pests and grass	Problem quite bad and persists	Social Group
2. Pest control method	Agrochemical dependence leading to pesticide treadmill. Pest resistance becomes a problem.	Social Group Profit Maximisation
3. Decision making process	Decisions taken mostly by advisor, owner often absent. No cross checks for a balanced action	Social Group

4.3.5 Systems analysis of the first survey results: interpretation of comparisons and discussion

Table 4.7 for group A indicates that problems with weeds and grass infestations became worse over the years, indicating a possible lack of control from poor husbandry which in turn was caused by the lack of labour. The smaller farms had very limited resources to cope with weeds. This group of farmers also seem to be under pressure to cut costs, which forced them to take some risks by not spraying in June against aphids. Therefore, in some cases, farmers from this group may have suffered from yield loss due to the lack of control in their crop protection system. The implication of such behaviour at a first glance is that profit maximisation was the prevailing paradigm. However it is not possible to say from the results so far whether the farmers were seeking to maximise financial gains as opposed to maximising profit in terms of the savings made in resources (labour, machinery, pesticide) from following their particular strategy. The comparison with the social group paradigm fits the description that a social group, namely these farmers, have the capability to collectively either increase or decrease the use of agrochemicals, depending on the type of decisions they have made. The comparison with the control paradigm shows that there can be breakdowns in the control provided by the agrochemicals used.

Group B (Table 4.8) appear to show some similarity with group A in that both decision making sub-systems used their own judgement on how best to protect their crop. The main difference is that group B still took information from the advisor in the later stages of the growing season, albeit to a lesser degree than at the beginning of the growing season. However just as for group A, a comparison with the chosen paradigms shows that lack of control caused by lack of resources both in financial resource and human resource caused problems with weeds to persist, that the farmers decided to cease application in May to maximise profit, and that they represent a group of people who can change the direction of the system they are involved with.

In Table 4.9, which deals with group C, the comparisons with the control, social group and profit maximisation paradigms show that this group of farmers have major problems with pest infestations because of the continuous cropping of their fields with cereals and that their perceptions of pest infestation are sufficiently intense that their pesticide requirements have increased over the years, exacerbating the various ecological problems including resistance problems. The social group paradigm applies because between them they have caused changes to the crop-pest relationship. Also, because the crop provides desirable returns, there appears to be no incentive to adopt other methods, like leaving a field fallow for a certain period. This fits the profit maximisation paradigm.

The Failures method has enabled the identification of areas that required further investigation, namely in the areas of decision making and farmers' attitudes towards their advisors as major sources of information on pest attacks. It has been argued that the type of system is distinguished according to the group of farmers who initiated it. The systems for groups A and B both show mobility of the advisor component. It could be proposed, therefore, that the importance of the source of information varied according to the season. Indeed, when the first survey was conducted the weather had been similar for the previous three years, a fact that might make the farmers resistant to changing their system. It was decided that a second survey would be needed to explore this and other issues surrounding the farmers' decision making processes.

Chapter 5 The aims and methods used in the second, main, survey

5.1 Introduction

The second survey was conducted to test the following hypothesis:

External information sources will not have a major impact on farmers' crop protection behaviour because farmers attitudes and beliefs modify information inputs to suit their own judgement.

This hypothesis has been developed from the earlier analysis because it was found in the first survey that the respondents changed their crop spraying method within the growing season, which suggested differences between intention and action or attitudes and behaviour. This brought into question the effectiveness of the advice given by advisors. The analysis of the first survey also showed a likely adjustment of the system boundaries, and in particular the timing of the inclusion of the advisor, in order to meet changed requirements. The information sources were therefore tailored by the respondents to suit their circumstances.

The second survey began at the start of the growing season in November 1993. The investigation involved asking the farmers to predict their behaviour regarding pesticide applications throughout the growing season, in particular whether they intended to apply pesticide around June or July as suggested by their advisors (the time when aphids can infest the crop badly). It was also planned to send another questionnaire in March 1994 to see if there were changes to their spraying intentions even if they intended to spray right through to July, as had been the case in the previous growing season. The questionnaires sent on both occasions were designed to measure both their attitudes and subjective norms, which could then be used to determine their intention towards performing or not performing the expected behaviour, as stated by the Fisbein-Ajzen model.

5.2 Methodology

This methodology is fully explained and illustrated in Chapter 6 by presenting the actual results. The text below is a brief summary of the process.

In order to investigate the revised hypothesis, there were three areas which were deemed necessary to be tested. These were respondents':

1. Attitudes toward agrochemicals
2. Attitudes toward hiring an external advisor
3. Intended choice of crop protection method at the beginning of the winter wheat growing season.

These areas were to be tested, as closely as possible, along the lines of the method designed by Fishbein and Ajzen as described in Chapter 4. The steps taken to test the above three areas were as follows:

At the beginning of the winter wheat growing season, the farmers were approached by personal contact or by mail depending upon the agreement reached with each individual farmer at the start of the research. Initially they were asked to indicate which of the following crop protection methods they intended to use during the growing season:

- a) Risk management method (to spray until end of spring).
- b) Insurance method (spraying until harvest).

Every respondent was asked to mark two bi-polar scales (see Section 5.3), each scale designed to measure the likelihood of the crop protection method being used. The answers were grouped according to the size of the holding i.e. a group where the respondents farmed more than 100 hectares and a group where the respondents farmed less than 100 hectares. This was intended to see if their attitude differed according to the likely value of the wheat crops.

Apart from asking them to indicate their choice intention, the respondents were also asked to list the advantages and disadvantages of:

- a) Using agrochemicals for crop protection.
- b) Hiring an external advisor.
- c) Each of the crop protection methods mentioned above i.e. risk management or insurance method.

The results were processed when all the participating farmers had completed their questionnaires. The answers to each issue were arranged according to the frequency of the beliefs elicited. These helped to identify the modal salient beliefs of each of the above issues. These modal salient beliefs then made it possible to get a general picture of the beliefs that represented the main determinants of the attitudes for the chosen sample of arable farmers. In deciding which of the beliefs to include in each modal set, it was concluded that the most frequently stated beliefs (about seventy five percent of the beliefs) were sufficient. Once these modal salient beliefs had been obtained, questionnaires to test farmers attitudes towards these issues were constructed. In constructing the questionnaires, care was taken to ensure that the statements were phrased so that the beliefs corresponded with the attitude toward the relevant behaviour. For every statement, there was a scale on which the farmer was asked to mark the strength of their belief. The purpose of this exercise was to gauge the attitude of the respondent toward each of the three issues above. The attitudes of the respondents could then be predicted by multiplying their evaluation of each of the consequences of their behaviour with their belief strengths.

The questionnaires for predicting the attitudes of the farmers to the above three issues were presented to them prior to the test on their subjective norms (normative beliefs). However information on the person(s) or group who would approve or disapprove of the farmer performing the behaviour in question was obtained at the same time as the

information on their attitudes. These persons or groups were then arranged according to how frequently they were mentioned so that they became the salient referents. The farmers motivation to respond was also tested using a scale ranging from 0 to +3. Once this had been done, the farmers normative beliefs were tested.

The results on both the farmers attitudes towards their intended behaviour and their normative beliefs were weighted using a double regression analysis. The standardised regression coefficients served as estimates of the weights of these two components (attitude and subjective norm) and showed which of these two components was the more important determinant in shaping their eventual behaviour.

5.3 *Attitude measurement*

An important aspect of the questionnaires used in this investigation (see Appendices 2 and 3) are the types of question used to help measure attitudes. The person who first proclaimed that attitudes can be measured was Thurston (1928). Many scientific scaling procedures have since been developed. The main methods and their advantages and disadvantages are noted below.

Question form

There are a number of methods for measuring attitude using this format.

(i) Open-ended questions.

A prepared question is proposed but the respondent is allowed to express his/her view in their own way, rather than choosing from a set of alternatives. For example, when Campbell and Schuman (1968) asked 1,886 white Americans what it was about Negroes that makes them have worse jobs and worse education, they expected the answers to be either genetics or environmental. Instead, most white Americans believed in a simple 'lack of motivation' for the cause. They believed that the Negroes should try harder. This striking finding would probably not have been discovered in a closed

question format. The problem with this open-ended format is that it is difficult and expensive to code and analyse and time consuming to administer.

(ii) Items to accept or reject.

This was first used by Allport and Hartman (1928). Using this method, respondents must indicate whether they agree or disagree with a specific statement. The drawback with this method is if a statement contains more than one idea, the response becomes hard to analyse, so statements must be carefully drafted to restrict them to one idea.

Attitude Scales.

(i) Items with multi-point rating scales.

Likert first used this method in 1932. Respondents are presented with several distinct levels of agreement and disagreement. The scale may be used to measure intensity with variables like 'strongly agree', to 'strongly disagree', or it can be used to measure frequency, as in 'never true' to 'always true'. Fishbein and Ajzen used similar techniques in measuring belief strength with variables such as 'not sure at all' to 'extremely sure'.

(ii) The semantic differential.

This is a method developed by Osgood et al (1959) where a word or short phrase is followed by a series of contrasting adjective pairs such as good-bad, harmful-beneficial, pleasant-unpleasant etc. Each pair appears at opposite ends of segmented lines.

Responses are usually scored from -3 on the negative side of such scales to +3 on the positive side. The sum of all scales is a measure of the respondent's attitude towards the statement. Criticism of this method is that the semantic differential does not go beyond the assessment of evaluation or effect (Ajzen and Fishbein 1980).

There are many possible ways to construct and score scale items. Scores may be added, multiplied, averaged, weighted differently or scored for adherence to almost any predetermined set of patterns. The Thurston scale is directly based on the concept of extremity such as the degree of strength or weakness that each item represents. The people who favour the most extreme items are given the highest score. The scale

should consist of items placed at equal intervals along the extremity dimension to ensure that the full range of opinions are collected. Each item is given a certain numerical score representing the degree of extremity. The scores of each item are predetermined by data from a panel of judges who evaluate a large number of items. The chosen items have scores along the continuum. The final scales score is the mean or median of the weights of items endorsed by a given respondent. The Thurston method assumes that each item should elicit agreement from persons who are close to the position of the items on the extremity scale, but rejected by those further away.

In contrast, in the summative method, also known as Likert scales, individual item scores are simply added and the resulting total is the scale score. The only requirement is that the items must at least be moderately correlated with each other, a condition that can be checked after the collection of data when deviant items can be dropped from the scales. The Fishbein and Ajzen method has a combination of attitude scaling methods and question form methods.

People have used Fishbein and Ajzen's methodology in various ways. In this survey, the analysis follows as closely as possible Fishbein and Ajzen's own prescription of how the empirical test should be done.

In presenting data, Fishbein and Ajzen stress the need for means of describing the strength of the relationships among variables of their approach. The most appropriate index for this purpose is the correlation coefficient or 'r'. A standard Spearman's rho test is used in this survey to find this coefficient. The coefficient can take on values that range from -1 through 0 to +1. The more the correlation between two measures departs from zero and approaches the value of either -1 or +1 the stronger the relationship will be between the two variables in question. It must be stressed here that correlation describes only the degree of linear relationship between two variables. Two

apparently uncorrelated variables may be related in a non linear fashion. Correlations greater than zero indicate that as the value of one variable increases, the value of the other increases as well. The converse also holds. Consider the relationship between attitude towards spraying through to harvest and intention to spray to harvest time. In this research, the respondents' answers provide measures of the attitudes and intentions in question. By calculating the correlation coefficient, as will be shown in Chapter 6, the results can describe the strength of the relationship between these two measures. A positive result means that it is more likely that respondents would spray right through to harvest time. The higher the correlation, the stronger the relationship and the better, according to Fishbein and Ajzen, a person's intention can be predicted from his or her attitude.

The significance of a correlation is if the relationship between two variables is unlikely to be due to chance alone. The empirical tests of this approach also require an index of the degree to which one variable i.e. intention can be predicted from simultaneous consideration of two other variables, namely attitude towards behaviour and subjective norm. This index can be provided by a multiple correlation coefficient (R) which can range from zero predictability to 1, perfect predictability. However, Fishbein and Ajzen themselves weighted the two predictor variables. These weights can be used as indicators of the relative importance of each component in the prediction of intention. This is useful in identifying whether respondents are motivated more by their own beliefs or by the influence of their advisors. To calculate these weights, a double regression analysis needs to be performed. The standardised regression coefficients indicate estimates of the weight of the above two predictor variables. Such weighting will be assessed in this research. Other researchers have chosen to use the model in a disaggregated form, to study the pattern of individual beliefs of various social groupings, e.g. Tait (1983), Carr (1988).

Chapter 6 Results of the second, main, survey

6.1 *Introduction*

The second, main survey was conducted in the growing season 1993 to 1994 and used the same sample of farmers identified for the first, preliminary survey. Whereas there were 31 respondents used throughout in the first survey it was decided to reduce the number used in the second survey to 20 for certain aspects to make the data collection more manageable, but still maintain adequate numbers for the statistical analyses.

6.2 *Organisation of respondent groupings*

Of the 20 respondents selected for the second survey, only 6 used independent external advisors. Although their numbers were not large enough to put them in a special category for the whole of the second survey, these six respondents were initially grouped at the early stage of the survey mainly to elicit their beliefs in hiring external advisors. Their scores were then compared to the scores of an equal number of respondents with commercial advisors as their external advisors.

When this stage had been completed, the 20 respondents were divided into two groups, each consisting of ten respondents. Group 1 was for respondents with holdings over 100 hectares (five of these were ones with independent advisors), while Group 2 was respondents with holdings less than 100 hectares. The remaining respondents from the first survey were put into a 'back up category' should any of the respondents within these two groups drop out for any particular reason.

The reason for grouping this way was because the systems analysis in Chapter 4 indicated that the smaller holdings differed from the larger ones in their crop protection behaviour. Therefore it might be expected that their attitudes too would be dissimilar.

6.3 *Salient beliefs on hiring an advisor*

Using the Fishbein-Ajzen methodology, the attitudes of the respondents to hiring an advisor were assessed through their salient beliefs about the subject matter. The results are shown below.

6.3.1 **Identifying beliefs / attitudes towards an external advisor**

To be able to assess either of the two group's salient beliefs on hiring an external advisor, a representative set of beliefs that were salient to each population of respondents needed to be identified. These 'modal' salient beliefs were obtained by eliciting beliefs from a representative sample of these respondents, with the beliefs most frequently elicited being judged as the modal set for that group of respondents. Table 6.1 shows a list of salient beliefs related to hiring an advisor elicited from a sample of thirty respondents. That is, the two specified groups plus the back up group.

Table 6.1 Ordering of salient beliefs of all 30 respondents about hiring an external advisor

Belief number	Salient beliefs concerning hiring an external advisor.	Frequency
1	Takes away the worry of detecting pests. Makes field checks easier.	16 10
2	Helps solve problems in farm.	18
3	Helps make greater returns/ increase profit.	12
4	Advice easy to obtain.	10
5	Can make me buy pesticide more than I need	10
6	Can use my fields as trial fields for a number of different chemical brands. Can be untrustworthy?	10
7	Means that I am getting advice which is better than no advice.	10

Table 6.1 shows in one or two cases that beliefs have been grouped into similar categories, for instance 'takes away the worry of detecting pests' and 'makes field checks easier'. This is because, after checking with respondents, it was clear that the two beliefs refer to the same issue. Therefore, with the two beliefs grouped together having a frequency of twenty-six, this group of beliefs is taken as belief number one, i.e. the most frequently stated belief. There is a degree of subjective judgement required in deciding which belief to include in the set to elicit the salient beliefs of the two (i.e. between the group with independent advisors and the group with commercial advisors). The final decision on which beliefs to include in the set for eliciting salient beliefs was to take 75% of all beliefs stated. This, according to Fishbein and Ajzen is the least arbitrary decision rule. In the case of this survey, 75% of the belief groups identified is equivalent to five out of seven of those listed.

6.3.2 Measuring beliefs: predicting the attitudes of respondents about hiring external advisors

Table 6.2 shows the difference in attitude to salient beliefs of the group with independent advisors (Grp 1) and the group with commercial advisors (Grp2) regarding hiring an external advisor.

Column two of table 6.2 shows the result of their evaluation of that belief on a scale from +3 to -3, e.g. the respondents evaluate whether using chemicals will benefit them by lessening the worry about pest infestations (see appendix for the actual questions and scales).

Column three is a measure of the strength of the beliefs, where respondents were asked to put their check mark on the following scale against those beliefs: Not at all certain (0), Slightly certain (+1), Quite certain (+2), Extremely certain (+3).

Column four shows the predicted attitude of the respondents, remembering that Fishbien and Ajzen's theory states that a person's attitude towards a behaviour can be assessed by multiplying the person's evaluation of a behaviour by the strength of the person's belief.

Table 6.2 Comparison of attitudes to modal salient beliefs of the 2 groups of respondents to hiring an advisor.

Beliefs of respondents about hiring an external advisor.	Evaluation score (e)		Belief strength score (b)		Product (e x b = attitude)	
	Grp 1	Grp 2	Grp 1	Grp 2	Grp 1	Grp 2
1. Makes the tasks of pest control easier.	+1.9	+1.6	+2	+1.5	+3.8	+2.4
2. Helps solve problems in farm.	+2.1	+1.3	+2.6	+1.1	+5.46	+1.43
3. Helps make greater returns.	+2.1	+1.1	+2.3	+1.2	+4.83	+1.32
4. Can make me buy more chemicals than needed.	-2.4	+2.1	+3	+1	-7.2	+2.1
5. Makes access to information easier.	+2.2	+2.2	+2.6	+2.1	+5.72	+4.62
Total:					+12.61	+11.87

Looking at the outcomes shown in Table 6.2, both groups show similar results in their evaluation of belief number one, i.e. the tasks of pest control are made easier by hiring an advisor. There are also slight difference in beliefs 2 and 3; although those with an independent advisor gave a higher score in their evaluations.

One point of interest is in the evaluation of belief number four, the belief that the advisors can make them buy more pesticide than needed. The group with independent

advisors strongly believed that their advisors would make them buy more pesticide than needed and that this would be bad, while for those with commercial advisors the opposite was true.

The last column shows the result of the predicted attitude of both groups towards hiring an external advisor. The products for all 5 beliefs tested were positive, i.e. indicating a favourable attitude towards hiring an advisor, except for belief number four and the group using independent advisors where the product is negative i.e. that had an unfavourable attitude to hiring independent advisors which may or may not make them buy more chemicals than needed. When the Group 2 respondents were asked about this, the majority of them said that because these advisors received remuneration according to the amount they managed to sell, the respondents were suspicious of the quantity of chemicals that were recommended. One of them said that his advisor had recommended he use several herbicides to combat blackgrass, but this did not produce a good result. This tendency to show less trust in commercial advisors is in line with findings published by Farmers Weekly (Anon 1984).

6.4 *Attitudes towards agrochemicals for pest control*

The survey also examined respondents' attitudes towards the use of agrochemicals for pest control. To elicit salient beliefs and so help predict their attitudes, the respondents were asked what they believed were the advantages and disadvantages of using agrochemicals for the control of all types of pests (Table 6.3). This list of beliefs in some way is similar to Carr's (1988) findings on the most relevant pesticide beliefs of farmers in Bedfordshire.

The respondents were also asked to evaluate their beliefs about certain aspects of pest control by asking them to put their checkmark on a series of bi-polar scales from +3 to -3 (see Appendix 2 for full details of these questions), and that for practical purposes

they should consider weeds, grass, fungi and insects as pests. The same procedure was used as for the previous question on hiring external advisors. The results are shown in Table 6.4.

Table 6.3 Ordering of salient beliefs of 30 respondents about the use of agrochemicals for pest control

Belief number	Salient beliefs about using agrochemicals for pest control	Frequency
1	Lessens the worry about infestation	26
2	Increases returns Increases expectation of better yields	10
3	No requirements for hand roguing Solve problems of labour shortage	10
4	Pest getting virulent Chemicals do not work if used too much Increase problems with resistance	3 6 8
5	Neighbours are worried about poisoning their land Environmentalists are concerned about ecosystem	4 5
6	Make the supplier and the maker of the chemicals richer	6
7	Can make me sick	3

The results in Table 6.4 show that overall, the attitude is favourable towards using agrochemicals for pest control, especially among those with larger farms (Grp 1).

Table 6.4 Comparison of attitudes to modal salient beliefs of the 2 groups of respondents about using agrochemicals for pest control

My using agrochemicals for pest control.	Outcome evaluation		Beliefs strength		Product	
Belief Number.	Grp1	Grp2	Grp1	Grp2	Grp1	Grp2
1. Lessens the worry about infestation	+2.6	+2.2	+2.1	+1.9	+5.46	+4.18
2. Increases expectation of better yields	+2.6	+2.1	+2.4	+1.9	+6.42	+3.99
3. Solves the problems of labour shortage	+2.3	+2.4	+2.2	+2.3	+5.06	+5.52
4. Increases problems with resistance	-0.6	-2.1	+0.9	+1.8	-0.54	-3.78
5. Get criticism.	-.5	-1.7	+1.1	+1.4	-0.55	-2.38
				Total	+15.67	+7.53

6.5 *Predicting behaviour from attitudes towards the use of agrochemicals: the choice of spraying schedule at the start of the growing season*

The survey examined respondents' intended spraying schedule, namely to spray right through to harvest time or to spray until spring only. To assess their intention, the respondents were asked to put a check mark on a unipolar scale against the relevant questions (see Appendix 3). Prior to asking the respondents to place their check marks on these scales, they were first given my interpretation of what these two schedules imply:

(i) Spray right through to harvest (Insurance spray)

To protect the crop from damage caused by pest infestations which could happen during the crop life, it is deemed sensible by some people to apply pesticide right through to harvest time, irrespective of any incidence of pest infestation. It is expensive

but it is also regarded as a relatively safe way of ensuring the expected yield and quality of the crop.

(ii) Spray to spring time only (Risk management spray)

To protect the crop from pest damage, it is agreed by some people that it is necessary only to apply pesticides at certain times before the crop has a full leaf canopy, which is around spring time. To spray post spring is considered wasteful unless there are signs of pest infestation as well as damage caused to plants.

The main point here is that when dealing with a choice intention there is the need to identify the options available. According to Fishbein and Ajzen, the relative strength of their attitude towards these options should predict the choice they would make. Thus there is the need to examine the determinants of intention of either of the spray methods. These determinants of intentions, according to Fishbein and Ajzen, are attitudes and normative beliefs. Furthermore, for a more thorough account of the factors that influence the choice, the beliefs that underlie the attitudinal and normative components also need to be examined.

6.5.1 Attitudes of the respondents

The first part of the investigation aimed to show that the respondents' choice of spraying schedule can be predicted by using the assessments of their intention to use the spray to harvest or spray to Spring time schedule, as collected using the method reported in the previous section (the actual questions used are shown in Appendix 3). Prior to eliciting their salient beliefs, their perceptions on the severity of the possible pest infestation were also tested using a bipolar scale (Table 6.5).

Table 6.5 Respondents' perceptions on the likely severity of pest attack by farm size

Farmer number	Respondent's score for Grp 1	Respondent's score for Grp 2
1	-2	0
2	-1	-1
3	-1	0
4	-2	+1
5	-2	-1
6	-2	-1
7	-2	0
8	-1	0
9	-2	0
10	-2	0

The results in Table 6.5 suggest that the two groups differed in their perception of the likely severity of pest infestation with the smaller farms fairly indifferent to pest problems in the coming season. Yet both groups intended to use the insurance spray schedule (twenty seven out of thirty respondents at the beginning of the growing season preferred spraying to harvest time). Group 1 perceived an infestation of substantial magnitude while Group 2 perceived an uncertainty of an infestation occurring, but both perceptions led to the same choice intention in their crop protection

method. In other words Group 1 expected a severe pest attack whereas Group 2 were simply unsure of what might happen.

Prior to completing the questionnaire, respondents from Group 2 were asked verbally what the pest situation would be during the growing season in question. Their answers were often ambiguous, such as: 'It is going to be normal'. A similar answer was given when they were asked what the weather pattern was predicted to be ('same as always'). This may have been because they were unsure themselves, or were reluctant to commit themselves to a clear answer. It was expected that clearer answers could be obtained when respondents were asked to score on the scale. However, many of them registered zero, which meant neither good or bad, or they were unsure. These respondents, it was later revealed through casual conversation, had experienced some infestations but never severe enough to suffer a substantial amount of damage or crop loss. Here it could be suggested that experiences of a lesser degree of infestation had not altered their belief that the regular application of agrochemicals had 'lessened the worry about pest infestation' (Table 6.3). The choice intentions of both groups also suggested that the respondents valued their crops as important enough to warrant a spraying method which does not require any actual evidence of pest infestation.

For each of the respondents, a differential intention was obtained by subtracting his response to the first spray schedule option from his response to the second spray schedule option. A resulting positive figure would indicate a preference by the respondent for using the insurance spray schedule and conversely a negative result would indicate a preference for the risk management spray.

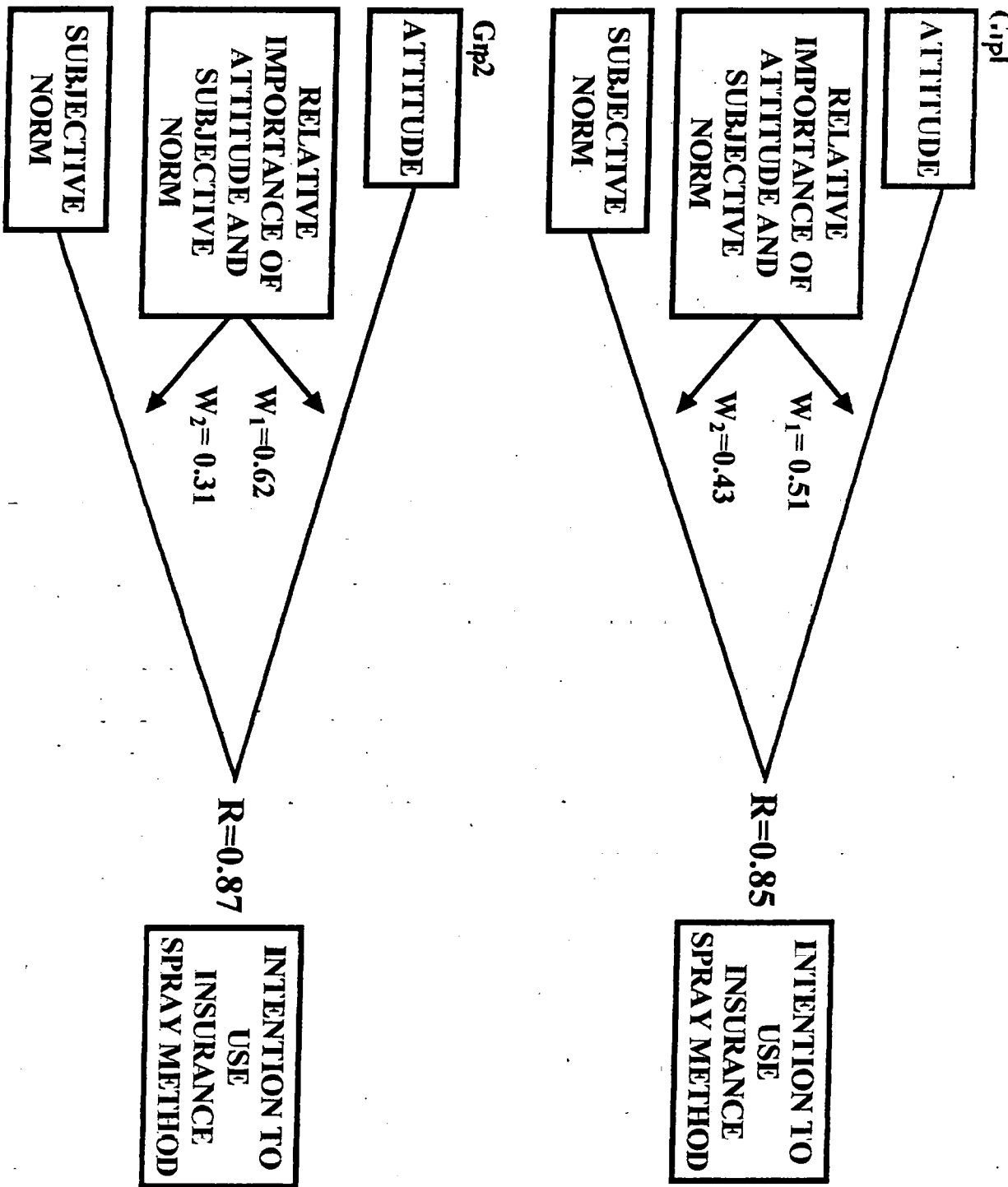
The differential intention was correlated with their estimated choice intention to predict their actual choice intention according to Ajzen and Fishbein (1980). The correlation between the differential (estimated) intention and the actual choice intention was

significant: $r=0.87$ for Group 1 and $r=0.88$ for Group 2. The correlation for the two groups combined is $r=0.51$. The difference in the choice between the two spraying methods needed to be accounted for and thus measures of their attitudes and subjective norms needed to be obtained. Again, the correlation calculation was done by correlating the differential attitude scores and the differential subjective norms to predict the differential intention: $r=0.85$ (Grp 1), $r=0.87$ (Grp 2). Twenty-seven out of thirty-one respondents at the beginning of the growing season preferred the method of spraying to harvest time.

The determinants were weighted and showed that differences in the respondents' attitudes towards using the methods were more important determinants of their ultimate choices than the differences in their subjective norms. The regression coefficients which provided these weightings or estimates of relative importance were 0.51 and 0.43 for attitudinal and normative components respectively for Group 1, while for Group 2, the regression coefficients were 0.62 and 0.31 for attitudinal and normative components respectively (see Figure 6.1).

Having established that respondents' attitudes were the more important determinants of their choice intention, a further examination of the beliefs that led to the choice intention was carried out. The respondents were asked what they believed were the consequences associated with the insurance spray schedule. This was done by contacting them by phone or meeting them informally. The lists of consequences were gathered and the ones most frequently cited selected. These were then presented to them for their evaluation.

Figure 6.1 The factors that determine farmers' eventual behaviour in the Fishbein-Ajzen model.



Tables 6.6 and 6.7 show the beliefs of farmers with large farms (Grp 1) and smaller farms (Grp 2) towards concerns surrounding the two spray schedules being used.

Table 6.6 Mean outcome evaluation and belief strengths of respondents using an insurance spray schedule, by farm size

Insurance Spray schedule	Outcome evaluation		Belief strength		Product	
	Grp1	Grp2	Grp1	Grp2	Grp1	Grp2
1. Gives feeling of security all throughout the growing season.	+2.5	+1.8	+2.3	+1.5	+5.75	+2.7
2. Is a method of pest control which is convenient and effective.	+2	+0.8	+2.6	+0.8	+5.2	+0.64
3. Cuts costs of hiring farm hands.	+1.8	+2.5	+2.0	+2.8	+3.6	+7.0
4. Guarantees expected output.	+1.9	+0.7	+2.1	+0.9	+3.99	+0.63
5. Maintains quality of crops.	+1.8	+1.5	+1.8	+1.3	+3.24	+1.95
6. Can lead to escalation of chemical dependency.	-0.7	-2.5	+0.8	+1.2	-0.56	-3.0
7. Is expensive.	-0.9	-2.5	+2.0	+2.8	-1.8	-7.0
8. Can lead to ecological damage.	-1.2	-1.8	+0.7	+0.8	-0.84	-1.44
Total					+18.58	+1.48

The results in Table 6.6 show that although both groups had overall positive attitudes to the insurance spraying schedule, the smaller farms were much less positive once again. For beliefs six, seven and eight, Group 1 showed only slight concern for the negative effects of insurance spraying, while Group 2, the smaller farms, showed strong concern for the negative effects.

The same set of beliefs were also presented to the respondents more favourable to the risk management schedule, but with one slight change in belief number 6. Instead of asking them to evaluate whether or not the escalation of chemical dependency resulting from the risk management method is good or bad, they were asked to evaluate if this consequence is likely or unlikely to occur using this alternative method.

Table 6.7 Mean outcome evaluation and belief strengths of respondents to the risk management spray method by farm size.

Risk management spray schedule	Outcome evaluation		Belief strength		Product	
	Grp.1	Grp.2	Grp.1	Grp.2	Grp.1	Grp.2
1. Gives security feeling throughout the growing season.	-1.5	+0.2	+2.2	1.	-3.3	+0.2
2. Is a method of pest control which is effective and convenient	-1.8	0	+1.2	0	-2.16	0
3. Cut costs of hiring farm hands.	-1.9	0	+1.1	0	-2.09	0
4. Guaranteed expected yield.	0	+0.4	0	+0.2	0	+0.08
5. Quality of crop maintained	0	0	0	0	0	0
6. Can lead to escalation of chemical dependency.	-1.8	-1.4	+1.5	+1.2	-2.7	-1.68
7. Is expensive.	0	0	0	0	0	0
8. Can cause ecological damage.	-1.4	-1.6	+1.5	+1.7	-2.1	-2.72
TOTAL					-12.35	-4.12

The results in Table 6.7 reinforce the previous findings that at the beginning of the growing season, the respondents from Group 2 were not certain whether or not the risk management spray would give them all the consequences that the insurance spray method would. On the other hand Group 1 showed a much stronger belief that the risk management method would not be able to provide the favourable aspects of the insurance spray method. Both groups were uncertain in their beliefs as to whether the chosen spray schedule would guarantee the expected yield or maintain the quality of crop produced. Both groups show similar beliefs with regards to the issues of chemical dependency and ecological damage; namely that the risk management spray schedule would lead to an escalation in chemical dependency or cause ecological damage.

6.5.2 Normative beliefs of the respondents.

As discussed before, subjective norms are also a function of beliefs, but instead of being part of people's behavioural beliefs, those beliefs are called normative beliefs. These involve an individual taking into account the normative beliefs of various other groups/ individuals in his/ her environment.

In order to see if normative beliefs were influential, respondents were asked who in their wheat production activities were important to them. The most frequent referents are listed in Table 6.8 and ranked according to their frequencies. The frequencies for the two groups were combined to obtain an overall order of importance for the referents.

Table 6.8 The frequency with which respondents said particular groups or individuals were important to their wheat production activities

Referent	Frequency of mention by Group 1	Frequency of mention by Group 2	Combined frequency of mention
Advisor	10	9	19
Client/food producer	7	5	12
Spouse	5	6	11
Grain merchant	4	1	5
Neighbours	1	3	4

These referents were used to elicit the two groups of respondents' normative beliefs with regard to the choice of spraying schedule in the same way as already shown for their salient beliefs, using bipolar and unipolar check scales (see Appendix 2). Care was taken here, as before, that the respondent's normative beliefs corresponded with the behavioural element of choosing the particular spraying schedule. The respondents were asked to indicate what score they would put on their motivation to comply with the referents' beliefs. The results of this analysis are shown in Table 6.9.

Table 6.9 shows that there is little difference between the normative beliefs of Group 1 and Group 2 with regard to what they think their referents want them to do, i.e. spraying until harvest time. The scores for motivation to comply are generally low and this corresponds with the result in the regression analysis. This is namely that the subjective norm is a less important determinant of these respondents intending to use the chosen spraying method. The social pressures are shown to be felt more by Group 1.

Table 6.9 Motivation to comply with referents' beliefs for both Groups 1 and 2

Referent	Normative belief		Motivation		Product	
	Grp.1	Grp.2	Grp.1	Grp.2	Grp.1	Grp.2
Advisor	+2.6	+2.2	+1.2	+0.9	+3.12	+1.98
Client	-1.1	-0.6	0	0	0	0
Spouse	+1.8	+1.9	+1.2	+1.1	+2.16	+3.42
Grain merchant	+2.1	+1.9	+0.9	0	+1.89	0
Neighbours	-2.1	-2.3	+0.8	+0.9	-1.68	-2.07
				Total	+5.49	+3.33

6.5.3 Respondents intended and actual behaviour by mid-season

In April 1994 the respondents were approached again and asked to fill in new questionnaires regarding their intention to spray (Appendix 3). The results of this questionnaire are given in Table 6.10, where all respondents in Group 1 and all but 3 respondents in Group 2 had concluded their spraying.

Everybody in Group 1 stated that they had no problems with pests now, while in Group 2, nearly all of them (seven) stated that the problem was under control. Three stated that there was a possible problem. These results were similar to the findings of the first survey (see section 4.1.5). The majority of the respondents declared that although initially they intended to spray until harvest they had decided that spraying until spring had been sufficient. They said their crops were in good condition and there were no substantial pest problems causing concern. They said they were satisfied that they were in a good position to prevent any infestation should such a situation occur.

Table 6.10 Respondents spraying intentions by mid season

Farmer number	Intention to spray by mid season	
	Grp 1	Grp 2
1	Concluded	Concluded
2	Concluded	Concluded
3	Concluded	Concluded
4	Concluded	August
5	Concluded	Concluded
6	Concluded	Concluded
7	Concluded	August
8	Concluded	Concluded
9	Concluded	August
10	Concluded	Concluded

6.6 Discussion

The second survey was conducted to understand farmers' behaviour with regard to the choice of spraying schedule. To do so, a method for prediction and for understanding behaviour was used. The chosen method was that devised by Fishbein and Ajzen. Using this method at the beginning of the growing season, it was predicted that the respondents were going to use the spraying regime which required them to apply

protection until harvest time. By spring, their intentions had changed. The change in intention was brought about by the respondents making decisions which were based on their experience. As shown in this chapter, overall the respondents of both Groups 1 and 2 had a favourable attitude towards having an external advisor. However since the merchant representatives main task is to sell arable products, a large number of respondents question their recommendations more than those of other advisors. Respondents' past experiences were used to judge whether or not further applications of chemicals were required given their crops' condition at the end of spring. At the beginning of the growing season, the farmers were not in a position to assess the pest status, neither were they in control of the weather which was changeable that year. It can be seen from their statements that further information had changed the beliefs which were previously salient at the start of the growing season.

At first glance, it appears that the Fishbein-Ajzen method failed to predict actual behaviour. This is discussed further in the next chapter, along with other general conclusions drawn from this research. However, the theory of reasoned action has identified, in the case of this survey, the underlying factors which contributed to the behaviour of the respondents. Figure 6.1 shows the relationship between attitudes, subjective norms and intentions to perform the insurance spraying method for both groups 1 and 2. For both groups, attitude is the more important determinant in forming intention to use the insurance spraying method. This is shown by the regression weights W (1 and 2). As mentioned before, attitude is in turn determined by the individual beliefs and their evaluation. Therefore in the case of these respondents it was the underlying beliefs and values that had formed their intention to perform a certain behaviour. Their normative beliefs did contribute to their actions but not to the same extent, especially in Group 2.

Chapter 7 Conclusions

7.1 Introduction

The conclusions that can be drawn from this research fall into two, albeit interrelated, groups: (i) the success of the chosen method to investigate farmers' decision making and (ii) whether the findings actually support the hypothesis proposed at the beginning of Chapter 5.

7.2 The Fishbein-Ajzen model of decision making: the theory of reasoned action

In obtaining the results of the survey, care was taken in maintaining high correspondence between the measures of attitude and subjective norm on the one hand and intentions on the other. Fishbein and Ajzen have stressed the importance of high correspondence between the variables because, according to them, without high correspondence between variables, predictive accuracy will decline.

In spite of the care taken in maintaining the high correspondence between the variables mentioned above, the results show that the respondents changed their intended behaviour by springtime. The attitudes and subjective norm did predict intention correctly, but did not predict behaviour. One possible reason is the failure to predict behaviour achievement in the theory of reasoned action. Central to Fishbein and Ajzen's method, is the individuals' intention to achieve a specific behaviour. Intentions, according to them, are indications of how hard individuals are willing to try to achieve the behaviour in question. Intentions are assumed to be the motivational factor that influence behaviour. Thus, according to the theory of reasoned action, the stronger the intention to perform a certain behaviour, the more likely should be its performance. However, although intentions are sometimes a good predictor of behaviour, this is not always the case because the performance of most behaviour depends to a certain

degree on non motivational factors, such as the availability of requisite opportunities and resources like time, money, skills, co-operation of others etc. (Ajzen 1991). These factors influence the extent of people's actual control over their behaviour. Ajzen suggests that an individual with the required opportunities and resources, who intends to perform the behaviour in question, will do so.

On the basis that behavioural achievements depend jointly on an individual's motivation and ability, the theory of reasoned action does not specifically take account of the extent to which the behaviour is under the individual's volitional control. For most respondents participating in this survey certain resources such as money and labour were in their control, while others aspects such as the weather pattern for the season or the likelihood of pest infestations were not under their control. Ajzen (1991) goes on to suggest that a more important factor than actual control is the perception of behavioural control. This could be a major shortcoming of the theory of reasoned action and is therefore one explanation for the inaccurate prediction of the respondents' behaviour. The locus of behavioural control is a generalised expectancy that remains stable across situations and forms of actions. For instance, a farmer may believe that, in general, his outcomes are determined by his own behaviour (internal locus control) yet at the same time he may believe that his chance of becoming an agricultural scientist are very slim (low perceived behavioural control). In the case of the farmers surveyed in this research, beliefs may have changed over time or their behavioural control was much greater than could be assumed from their intentions since most had sprayed at least once and it was only later sprays which were dropped in the light of new information. Indeed, the appearance of new information, of new intervening variables between eliciting intentions and actual behaviour, is always likely to have a greater impact the bigger the time difference. Fishbein and Ajzen acknowledge that prediction is likely to be better the nearer the time of behaviour that attitudes and subjective norms are measured.

As noted at the end of Chapter 6, it was the respondents' own beliefs which motivated them to think at the beginning of the growing season that they would need to use an insurance spray method in order to achieve the expected yield. The method of insurance spray was perceived at this particular time as the best to protect their crops. The changes of intentions expressed in the interviews by spring time were probably not arbitrary but probably followed systematically from changes in beliefs brought about by exposure to new information. In other words, by spring the respondents had sufficient new information about the state of their crops that they were prepared to use the risk management method. By then they had sufficient information about the season's weather conditions and likely incidence of damaging pest attacks to judge that they would be able to control a pest outbreak should it occur. That is, they considered the situation to be under their own behavioural control (not outside it, as earlier in the season).

7.3 *A revised model for predicting behaviour: the theory of planned behaviour*

From the results obtained it can be concluded that the theory of reasoned action is not always reliable at producing accurate predictions of a person's behaviour from his/her attitude toward an object. It has also been mentioned that the resources and opportunities available to a person would, to a certain degree, determine the likelihood of behavioural achievement. These two factors are a person's means of control on the situation. However, the perception of control and the impact on intentions and actions are of greater psychological interest than the actual control itself. Ajzen (1991) proposed a model called the theory of planned behaviour which puts the emphasis on the perception of behavioural control (Figure 7.1). This model was designed by Ajzen to remedy the weakness of the theory of reasoned action. According to Ajzen's theory of planned behaviour, perceived behavioural control combined with behavioural

intention can predict accurately behavioural achievement. Ajzen offered two rationales for this hypothesis.

First, treating intention as a constraint, the efforts spent to bring a course of action to a successful outcome is likely to increase with an increase in perceived behavioural control.

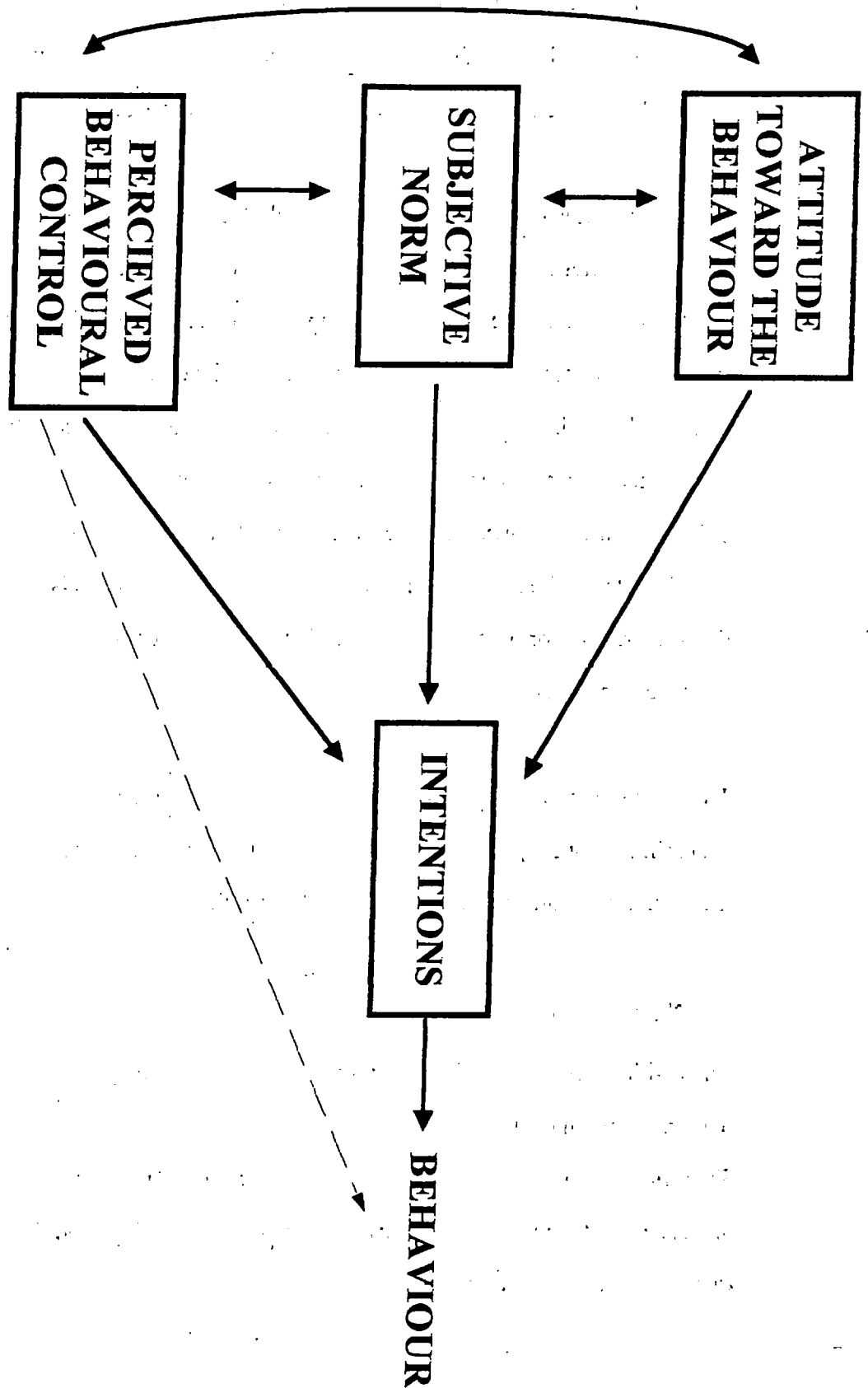
Second, the direct link between perceived behavioural control and behavioural achievement is that perceived behavioural control can often be used as a substitute for a measure of actual control. However, perceived behaviour control can '*only*' add more accuracy than the theory of reasoned action when the person has sufficient information about:

- (a) when requirements or available resources have changed, or
- (b) when new and unfamiliar elements have entered into the situation.

This theory only differs from the theory of reasoned action by the addition of perceived behavioural control. There are three conditions that must be met in this new model:

- (a) Intentions and perceptions of control must be assessed in relation to the behaviour in question and the specified content must be the same as that in which the behaviour is expected to occur. For example, if the behaviour is to spray for aphids on wheat, then the intentions and perceptions of control assessed must be to spray for aphids on wheat, not to spray pesticides in general.
- (b) The second condition for accurate prediction is that intentions and perceived behavioural control must remain stable in the interval between their assessment and observation of behaviour. Other events may produce changes in intentions or in the perceptions in behavioural control which prevent the original measures of these variables from producing accurate predictions of behaviour.

Figure 7.1 A diagrammatic model of the theory of planned behaviour (Ajzen 1991).



- (c) The perceived behavioural control must be achievable. For example, when the intention is to spray for aphids, the perceived behavioural control in this case must be the availability of funds to purchase the pesticides and labour to operate the machinery. If, for instance, the access to the funds is blocked because credit is denied then it would be impossible to achieve the behaviour

However, in this new model Ajzen also included control beliefs. Among the beliefs that ultimately determine intention and action is a set of beliefs that deals with the presence or absence of requisite resources and opportunities. These beliefs are called control beliefs which may be based in part on past experience with the behaviour but they will usually also be influenced by second-hand information about the behaviour, by the experience of other people such as friends, consultants etc., and by other factors that either increase or reduce the perceived difficulty of performing the behaviour in question. Thus, the more resources and opportunities individuals believe they possess, the less problem or obstacles they anticipate, the greater are their perceived control over the behaviours.

This new model of Ajzen's was only recently published and so was not used in designing the survey described in this thesis. However, further research in the manipulation of attitude using this model is required.

7.4 Testing the hypothesis

The results presented in Chapter 6 appear to support the hypothesis set out at the beginning of Chapter 5:

External information sources will not have a major impact on farmers' crop protection behaviour because farmers attitudes and beliefs modify information inputs to suit their own judgement.

Although external information sources did influence farmers' crop protection decisions there was varying influence depending on the source, with independent advisors being rated more highly than commercial advisors. Moreover there was little motivation to listen to any of the main referents. On the whole the first part of the hypothesis is supported: information sources did not influence the farmers crop protection behaviour.

As to the second part of the hypothesis, then it was the case that farmers' own attitudes and beliefs played a significant part in their crop protection decisions, particularly those with larger farms and particularly their beliefs about using agrochemicals for pest control. Indeed, they were able to adjust their actions, contrary to their measured beliefs, in the light of new information as the growing season progressed.

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Appendix 1

Name of farm:

First Survey _

Owner:

Manager:

Questionnaire I

- 1a) How many acres do you farm?
- 1b) How long have you farmed here?
- 2) Are you a,
 - ◆ Cattle and arable farm
 - ◆ Arable farm
- 3a) How many acres of your field carry winter wheat?
- 3b) How many farm hands do you employ? If you do not hire any, how many people are actually working your fields?
- 4) What types of soil do you have in your fields with winter wheat?
- 5) What problems do you have with pests and diseases?
- 6a) Did you ever suffer from severe yield losses due to pests and diseases? Please explain why it happened.
- 6b) Do you think you will ever experience such losses? If yes, please explain why you think so.
- 7) What do you do to prevent severe losses (if you have not suffered before), or stop it from recurring?
- 8) Where do you get your information on agrochemicals (if you are using them). Please list according to their importance.
- 9) Do you find these sources of information useful? If yes, please indicate in what areas they are useful to you.
- 10) What chemicals for crop protection do you use most? Please list according to their importance.
- 11) If you are a mixed cattle and arable farm, how valuable is your winter wheat to you in terms of income?
- 12) Will you be growing winter wheat again next season?

- 13) What do you think the weather pattern is likely to be next season given that we have had drought for the last three years? How does it affect problems with pests and diseases?
- 14) How many times do you spray chemicals to protect your crop during a season?
- 15) Is the spray policy:
 - ◆ Your own. If yes, please skip question 16.
 - ◆ The advice of an external advisor(s). If yes, please answer question 16.
- 16) Do you trust their judgement?
- 17) In managing the farm, who do you regard as important to you and whose opinion you regard as worth considering?
Please list according to importance.
- 18) Do you use a microelectronic system in running your farm, if so for what areas? If you do not, please skip the next question.
- 19) If you are using your microelectronic system for crop husbandry and crop protection, from where do you obtain the software?
- 20) If you do not use a microelectronic system, do you consider having one in the near future?

Appendix 2

Salient Beliefs

Risk Management Spray Method

1) Gives feeling of security throughout the growing season.

Likely	_____	:	_____	:	_____	:	_____	:	_____	:	_____	:	_____	Unlikely
	+3		+2		+1		0		-1		-2		-3	

2) Is a method of pest control which is convenient and effective.

Likely	_____	:	_____	:	_____	:	_____	:	_____	:	_____	:	_____	Unlikely
	+3		+2		+1		0		-1		-2		-3	

3) Cut costs of hiring farm hands.

Likely	_____	:	_____	:	_____	:	_____	:	_____	:	_____	:	_____	Unlikely
	+3		+2		+1		0		-1		-2		-3	

4) Guarantees expected output

Likely : : : : : : Unlikely
 +3 +2 +1 0 -1 -2 -3

5) Maintains quality of crops

Likely : : : : : : Unlikely
 +3 +2 +1 0 -1 -2 -3

6) Can lead to escalation of chemical dependency.

Bad : : : : : : Good
 -3 -2 -1 0 +1 +2 +3

7) Is expensive.

Bad : : : : : : Good
 -3 -2 -1 0 +1 +2 +3

8) Can lead to ecological damage.

Bad	_____	:	_____	:	_____	:	_____	:	_____	:	_____	:	_____	Good
	-3		-2		-1		0		+1		+2		+3	

Belief Strength:

For Q1.

☐

Not at all certain

☐

Slightly certain

☐

Quite certain

☐

Extremely Certain

For Q2.

☐

Not at all certain

☐

Slightly certain

☐

Quite certain

☐

Extremely Certain

Q3.

☐

Not at all certain

☐

Slightly certain

☐

Quite certain

☐

Extremely Certain

Q4.

☐

Not at all certain

☐

Slightly certain

☐

Quite certain

☐

Extremely Certain

Q5

☐

Not at all certain

☐

Slightly certain

☐

Quite certain

☐

Extremely Certain

Q6

☐

Not at all certain

☐

Slightly certain

☐

Quite certain

☐

Extremely Certain

Q7

☐

Not at all certain

☐

Slightly certain

☐

Quite certain

☐

Extremely Certain

Q8

☐

Not at all certain

☐

Slightly certain

☐

Quite certain

☐

Extremely Certain

Please put your check mark on the following scale:

My advisor thinks that													
I should not	_____	:	_____	:	_____	:	_____	:	_____	:	_____	I should	
	-3		-2		-1		0		+1		+2		+3
Spray to Harvest													

In general, how much do you want to do what this referent suggests?

☐ Not at all
 ☐ Slightly
 ☐ Quite
 ☐ Extremely

My Client thinks that													
I should not	_____	:	_____	:	_____	:	_____	:	_____	:	_____	I should	
	-3		-2		-1		0		+1		+2		+3
Spray to Harvest													

In general, how much do you want to do what this referent suggests?

☐ Not at all
 ☐ Slightly
 ☐ Quite
 ☐ Extremely

My Wife thinks that													
I should not	_____	:	_____	:	_____	:	_____	:	_____	:	_____	I should	
	-3		-2		-1		0		+1		+2		+3
Spray to Harvest													

In general, how much do you want to do what this referent suggests?

☐ Not at all
 ☐ Slightly
 ☐ Quite
 ☐ Extremely

The grain merchant thinks that													
I should not	_____	:	_____	:	_____	:	_____	:	_____	:	_____	I should	
	-3		-2		-1		0		+1		+2		+3
Spray to Harvest													

In general, how much do you want to do what this referent suggests?

☐ Not at all
 ☐ Slightly
 ☐ Quite
 ☐ Extremely

Clusters of neighbours think that													
I should not	_____	:	_____	:	_____	:	_____	:	_____	:	_____	I should	
	-3		-2		-1		0		+1		+2		+3
Spray to Harvest													

In general, how much do you want to do what this referent suggests?

☐ Not at all ☐ Slightly ☐ Quite ☐ Extremely

Appendix 3

Please put your check mark on the following scale:

My advisor thinks that													
I should not	_____	:	_____	:	_____	:	_____	:	_____	:	_____	I should	
	-3		-2		-1		0		+1		+2		+3
Spray to Spring													

In general, how much do you want to do what this referent suggests?

☐ Not at all
 ☐ Slightly
 ☐ Quite
 ☐ Extremely

My Client thinks that													
I should not	_____	:	_____	:	_____	:	_____	:	_____	:	_____	I should	
	-3		-2		-1		0		+1		+2		+3
Spray to Spring													

In general, how much do you want to do what this referent suggests?

☐ Not at all
 ☐ Slightly
 ☐ Quite
 ☐ Extremely

My Wife thinks that							
I should not	_____	:	_____	:	_____	:	I should
	-3		-2		-1		0
					+1		+2
							+3
Spray to Spring							

In general, how much do you want to do what this referent suggests?

☐ Not at all
 ☐ Slightly
 ☐ Quite
 ☐ Extremely

The grain merchant thinks that							
I should not	_____	:	_____	:	_____	:	I should
	-3		-2		-1		0
					+1		+2
							+3
Spray to Spring							

In general, how much do you want to do what this referent suggests?

☐ Not at all
 ☐ Slightly
 ☐ Quite
 ☐ Extremely

Clusters of neighbours think that							
I should not	_____	:	_____	:	_____	:	I should
	-3		-2		-1		0
					+1		+2
							+3
Spray to Spring							

In general, how much do you want to do what this referent suggests?

☐ Not at all ☐ Slightly ☐ Quite ☐ Extremely

April 1994

Questionnaire 3

1. How many more applications do you intend to do?

2. What is the status of the pest problem in your field?